Alternatives

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ALTERNATIVES

INTRODUCTION

The *National Environmental Policy Act* (NEPA) requires that federal agencies explore a range of reasonable alternatives and analyze impacts that the alternatives could have on the natural and human environment. The "Environmental Consequences" chapter of this elk and vegetation management plan and environmental impact statement (plan/EIS) presents the results of the analyses. The alternatives under consideration must include a "no-action" alternative as prescribed by 40 CFR 1502.14. Alternative 1 in this plan/EIS is considered to be the "no-action" alternative as it is the continuation of current management of elk and vegetation, and it assumes that the National Park Service (NPS) would not make major changes to the current management program. The four action alternatives presented in this chapter were developed by the interagency planning team, which included federal, state, and local agencies, and through feedback from the public during the public scoping process.

Each of the four action alternatives analyzed in this plan/EIS meets, to a large degree, the management objectives for elk and vegetation and also addresses the purpose of and need for action as expressed in the "Purpose of and Need for Action" chapter. Because each action alternative responds to the objectives and is technically and logistically feasible to implement, all are considered "reasonable."

This chapter describes the development process of the alternative for this plan/EIS. It also describes each alternative, summaries of the important features of the alternatives, their effectiveness in meeting objectives of this plan/EIS, and a summary of the effects of the alternatives on park and regional resources. The chapter also identifies actions or alternatives eliminated from further consideration and discusses the environmentally preferred alternative.

ALTERNATIVE DEVELOPMENT

The alternatives were developed based on an understanding of this plan/EIS's purpose, need, issues, and objectives, as well as from input from the public obtained during the scoping phase of the project. The National Park Service and cooperating agencies conducted numerous internal workshops to define the range of alternatives based on the objectives of the plan. Preliminary alternatives considered actions that other agencies on the planning team might take to address elk-related issues outside the park. After much deliberation, those agencies decided to take no additional actions to reduce the elk population or to redistribute the population outside the park in conjunction with this plan.

The alternatives therefore were structured so that all new actions to manage elk and vegetation would be conducted within the park boundaries. Based on public input and agency needs, the range of alternatives captures the most divergent, yet reasonable, scenarios that could be implemented within the park. Each alternative to a large degree emphasizes a different management technique or a combination of techniques, such as lethal reduction, fertility control, wolf release, or fence installation. After defining the range of alternatives, the National Park

Service held workshops with experts in various disciplines such as fertility control, lethal reduction, and wolves to define and revise the detailed actions within each action alternative.

The National Park Service realized at the onset of the planning process that the alternatives must include a formal monitoring program to adequately assess the effectiveness of the program and its effects on other park resources, and that any plan needed to be based on adaptive management, allowing modification of management actions within the framework of each alternative based on future research and monitoring information.

Method for Arriving at Alternatives

Since elk reductions in the park were eliminated in 1969, elk numbers and densities have increased and vegetation has changed, particularly a decline in montane riparian willow and aspen on the elk range. The appropriate elk population size and distribution and its associated effects on plant communities and biodiversity have been increasingly questioned.

In 1994, a research initiative by the National Park Service and the U.S. Geological Survey (USGS) began gathering critical scientific information needed to develop a management plan (Singer and Zeigenfuss 2002). In addition, the park began synthesizing the historical information and research on the Rocky Mountain National Park / Estes Valley elk population dynamics and their effects on vegetation conditions and animal populations in and around the park (Monello et al. 2005). This synthesis also discussed the major findings from Rocky Mountain National Park in the context of similar scientific studies that have been conducted elsewhere.

Part of the research initiative involved an ecosystem simulation model, SAVANNA, (Coughenour 2002) to evaluate the population dynamics and ecological effects of elk and to predict the effects over time of different management strategies on vegetation on the primary winter range. This computer model was customized for Rocky Mountain National Park to provide an objective tool to evaluate past, present, and future elk and vegetation conditions under different management scenarios.

The model incorporated herbivore numbers, willow sizes and densities, and hydrologic conditions at the time the model was run to predict plant responses to varying levels of herbivory, fences, and predation across a 50-year period beginning in 1999. Modeling conducted by Coughenour (2002) predicts how vegetation within the primary winter range would respond to different target elk population levels. Three elk management scenarios simulated never reducing the elk population size, reducing it to 1,600 to 2,100 animals (mid-to-high end of the natural range) with 600 to 800 wintering in the park and 1,000 to 1,300 wintering outside the park, and reducing it to 1,200 to 1,700 animals (low-to-mid end of the natural range) with 200 to 400 wintering in the park and 1,000 to 1,300 wintering outside the park. The ranges of elk in the two reduction scenarios represent two historic periods in the park, the lower range representing the historic elk population prior to establishment of the park, and the second, or higher, range representing the size of the population when it was managed prior to 1968. The three elk reduction scenarios were repeated with and without fencing of all willow and aspen on the elk primary winter range inside the park. In the simulations, beaver were assumed to start at existing levels and then gradually restored to natural levels over a 25-year period.

Based on recent elk population monitoring data, the town subpopulation may be within the natural range of variation, with estimates ranging between 1,000 and 1,400. Recent declines in the subpopulation estimates have coincided with drought, several significant snowfall events, and a potential change in distribution of elk eastward. It is uncertain whether any shifts in distribution are temporary or long-term. The park subpopulation is expected to continue to fluctuate outside the natural range of variation between 800 and 1,100 animals (Coughenour 2002). To allow

management of both subpopulations, lethal reduction actions could occur any time of year inside the park. However, to allow for the greatest opportunity to reduce the park subpopulation, most lethal reductions would likely take place between November and February.

Using the large body of ecological knowledge gathered in the park as well as similar scientific information from other areas and model predictions, the National Park Service developed alternatives that combined different management tools with differing elk population levels to achieve to the greatest extent the management objectives of this plan/EIS. Based on this information, the National Park Service and cooperating agencies agreed that to best protect park resources, the elk population would need to be brought down to a level within the natural range of variation. Therefore, each alternative achieves to the extent practicable a population size that fluctuates within the natural range of variation: 1,200 to 2,100 elk with 200 to 800 wintering inside the park and 1,000 to 1,300 wintering outside the park.

Elk Population

The team used results of elk population modeling (Hobbs and Bradford 2003, Bradford and Hobbs 2006) to estimate the number of animals that would need to be removed or controlled annually over the 20-year timeframe of the plan to achieve and maintain the target elk population size under each action alternative. This allowed the team to assess the effort required to stabilize the elk population at target population sizes and to quantify some of the risks involved in achieving those targets, including having an overabundant elk population or a population so small that extirpation (loss of a population) becomes possible. For example, modeling showed that removing a large number of animals in a single year coincident with high levels of natural mortality brought on by some unusual event (an extreme snowstorm or catastrophic wildfire) could reduce elk numbers to unacceptably low levels (Hobbs and Bradford 2003). By reducing the population size over a slightly longer period and at lower rates of reduction, the National Park Service could account for these unusual events and their effects on population and could compensate by varying elk reduction levels annually to achieve the overall target population range.

The population model incorporates mortality from all sources, including hunter harvest outside the park. Hunter harvest outside the park is an important variable. The Colorado Division of Wildlife manages the elk population outside the park consistent with population management objectives specified in individual population management plans, primarily through hunter harvest. Hunting is expected to continue to contribute to management of the population under all alternatives. Since 1999 annual hunter harvest levels in the Estes Park area (Game Management Unit 20) have typically increased, ranging from 343 elk in 1999 to over 700 elk in 2006, as hunter numbers have increased.

As the elk population fluctuates due to variables such as immigration or emigration, environmental conditions, and hunter harvest, the number of elk lethally removed or controlled would vary from year to year. The numbers of elk to be lethally removed or controlled under each action alternative is therefore presented as a range to take into account uncertainty and interaction of these variables as park staff determine the number of elk to be managed each year. The range of elk to be lethally removed is based on current modeling and monitoring information and the best professional judgment of NPS staff and scientists. It is a representation of what is most likely to occur under each action alternative, however, as information on the population and modeling is improved or refined over time, the minimum and maximum of the range may change. If more elk need to be removed under the selected alternative, an evaluation of the effects of that

number would be undertaken to ensure that the level of impact on park and regional resources as presented in the plan/EIS are not exceeded.

The strategies to regulate the population size that the team felt were most effective and efficient in meeting objectives were lethal removal, fertility control supplemented by lethal removal, and/or release of wolves supplemented by lethal removal.

Vegetation

Aspen

The ecosystem simulation model was used to simulate aspen cover on the core elk winter range. In all model runs, aspen cover on the core winter range declined from current levels under all elk population scenarios. Only when elk were removed could aspen persist or increase on the core winter range (Coughenour 2002). However, these runs did not include changes in elk densities or distribution, which could alter the effect of elk on aspen conditions (e.g., W. Baker et al. 1997). A follow-up ecosystem modeling effort to more intensively examine the effects of elk density on aspen regeneration indicated that aspen were able to regenerate and produce new cohorts in the presence of lower elk densities (less than 26 elk/mile^2), depending on the amount of time elk spent feeding in aspen stands (Weisberg and Coughenour 2003).

It is uncertain when aspen established in the area that is now Rocky Mountain National Park, how its distribution fluctuated, and whether aspen found in the grassland areas of the primary winter range was present prior to elk extirpation by 1880 (Monello et al. 2005). Until obtaining more information on the establishment of these aspen clones, the National Park Service would take action to preserve the aspen on the elk range. Due to the highly degraded condition of the aspen on the elk range and the uncertainty of success that could be achieved with elk redistribution techniques, to prevent the loss of the aspen clones on the elk range, all of the action alternatives incorporate the option to fence aspen to facilitate achieving the management objectives.

Montane Riparian Willow

Ecosystem modeling predicted that willow would respond positively to lower elk numbers, with the degree of response related to the amount of population reduction. When the elk population size was reduced and maintained at the lower end of the natural range of variation, willow conditions improved markedly, whereas when the population was maintained at the higher end of the natural range of variation, willow cover only slightly increased. Therefore, those alternatives that maintain a higher target elk population would require the use of fences and redistribution methods (e.g., herding, aversive conditioning, or lethal reduction with unsuppressed (noisy) weapons) to achieve willow recovery objectives due to the degraded condition of willow on the elk range. Alternatives that aggressively reduce the population early in the plan and either maintain a target population size at the low end of the range of variation or use wolves to redistribute elk would require no fencing of willow to meet the objectives.

Based on consideration of the costs to install large amounts of fences and of the impacts that fences may have on wilderness and the park visitor experience, alternatives were developed that involved minimal use of fences to protect montane riparian willow (Alternative 2 and 5). In these alternatives, the elk population would need to be reduced quickly to allow vegetation recovery that meets objectives within the life of the plan. Alternatives that result in a more gradual reduction of the elk population to a higher population level that allows maximum viewing

opportunity of elk in the park would therefore require the use of fences to protect montane riparian willow to meet vegetation management objectives (Alternatives 3 and 4).

To estimate the expected fencing requirements needed to meet the aspen and willow restoration objectives, the total acreage of these vegetation types was considered in relation to use of various redistribution techniques that the action alternatives would employ to achieve local elk densities that allow establishment and growth of new plants. The amount of fence proposed in the action alternatives to protect vegetation is based on current park vegetation maps and GIS analysis, park specific scientific research (e.g. Cooper et al. 2003 and Peinetti 2002), vegetation and hydrologic site-specific conditions, and best professional judgment where data on vegetation condition is not available. The amount of fencing needed to restore riparian willow habitat includes areas determined to be suitable willow habitat as defined by Cooper et al. 2003. These areas currently fall within the "meadow" habitat type, but are places where willow would be expected to occur because current water tables are adequate. For aspen, the current vegetation map of the park was used to select categories that include *Populus tremuloides*, but have no or only a limited conifer component.

The action alternatives present the best estimate for expected amount of fencing at this time. However based on monitoring and on ground surveys to confirm acreages (ground-truthing) the amount of fencing needed may be adjusted in the future to achieve vegetation management objectives.

The National Park Service recognizes that the management alternatives were developed with scientific information and data, including models, that are provisional and possibly imprecise. In light of this uncertainty, the alternatives include the principal of adaptive management, which approaches management as a learning process or continuous experiment in which incorporating the results of prior actions allows managers to remain flexible and adapt to uncertainty. Therefore, the National Park Service would continue to incorporate annual elk and vegetation monitoring data, including results of the previous year's hunter harvest, and the best available science to guide management actions, ensuring progress toward meeting the plan's objectives. See "Adaptive Management" in the section "Elements Common to All Action Alternatives" for a more detailed explanation of monitoring and adaptive management.

ELEMENTS COMMON TO ALL ALTERNATIVES

The following actions to manage elk and vegetation within the park would be common to all alternatives, including Alternative 1, which would continue current management.

Elk Management

Under all alternatives, the park staff could use some aversive conditioning methods to move individual elk exhibiting aggressive behavior. This may involve a variety of methods, including noise, visual stimuli, rubber bullets, cracker shells, or other non-lethal projectile rounds. If the threat is deemed great enough, individual elk could be lethally removed.

Chronic Wasting Disease Prevalence Testing

Opportunistic testing for chronic wasting disease would continue under all alternatives inside the park. Alternatives differ in their ability to facilitate testing and to increase the agencies' knowledge of prevalence within the park, depending on the availability and number of carcasses, development of a live test for chronic wasting disease in elk, and capturing elk as part of the alternatives. Each alternative provides a more detailed description of how samples would be collected and the degree of testing that would occur to estimate prevalence within the park. Park staff would continue under all alternatives to manage elk inside the park in accordance with NPS chronic wasting disease policy and established park protocols. Elk suspected of having chronic wasting disease would be lethally removed and tested. Elk targeted for lethal removal because of suspected chronic wasting disease would be disposed of appropriately (i.e., incinerated or chemically digested). When possible, elk carcasses found within the park would be removed and tested for chronic wasting disease and those that test positive for the disease would be disposed of appropriately.

Vegetation Protection

The park currently uses limited fencing for localized plant protection in areas where landscape plants used for revegetating areas require protection from elk foraging. Within the park, fences that were established for research purposes would continue to be maintained as long as needed for research or monitoring purposes. These research exclosures exclude large ungulates from foraging on approximately 12 acres of willow, aspen, grassland, and upland shrub vegetation in Beaver Meadows, Horseshoe Park, Tuxedo Park, Moraine Park, and Buck Creek on the primary winter range, and in the Kawuneeche Valley on the primary summer range. Research conducted in a number of these plots contributed to the knowledge of the effects that ungulate grazing has on park vegetation, such as willows and aspens, which led to the initiation of this plan/EIS (e.g., Singer et al. 2002; Olmsted 1997).

Wilderness Minimum Requirement / Minimum Tool Analysis

All alternatives would involve activities, in designated or recommended wilderness areas within the park. As such, in accordance with the Wilderness Act and NPS policies, the National Park Service must complete a minimum requirement analysis before taking management actions. This analysis documents whether administrative activities affecting wilderness resources or the visitor experience are necessary, and how to best minimize impacts. The minimum requirement analysis is a two-step process. The first step determines whether the proposed action is appropriate or

necessary for administration of the area as wilderness and whether it poses significant impact on wilderness resources and character. The second step analyzes the techniques and types of equipment needed for the action to minimize impact on wilderness resources and character. The alternatives for elk and vegetation management include activities or the use of tools that would be subject to a minimum requirement analysis. Each alternative description discusses the specific activities and/or tools that would be subject to a minimum requirement analysis. A programmatic analysis has been completed evaluating the elements associated with the action alternatives and is appended to this final plan/EIS in Appendix G. Final determination of what methods would be used for site-specific actions to manage elk and vegetation will be further evaluated and determined when the National Park Service completes the minimum tool analysis prior to implementation of actions of this plan/EIS.

Natural Wolf Recolonization

Colorado is part of the gray wolf's native range, but wolves were eradicated from the state by 1930. Over the past decade, the U.S. Fish and Wildlife Service has reintroduced gray wolves into Wyoming, Idaho, Montana, New Mexico, and Arizona. Currently the gray wolf is listed as a federally endangered species. To prepare for future natural migrations of wolves into Colorado, the Colorado Division of Wildlife formed a multi-disciplinary working group, which includes the National Park Service, that developed a wolf management plan adopted by the Colorado Wildlife Commission in June 2005. In November 2005, the wolf working group was tasked to continue discussions through 2006, focusing on who should decide on potential reintroduction of wolves to Colorado and how to structure a compensation program. The park would continue to work with the wolf working group and other federal, state, and local agencies on regional wolf issues such as natural wolf recolonization or a regional restoration effort. The park would also continue to monitor for natural wolf recolonization within its boundaries and would manage adaptively (see "Monitoring and Data Collection" section for more details on adaptive management).

ALTERNATIVE 1

Alternative 1 would involve the continuation of current management of elk and vegetation within the park. Because Alternative 1 represents current management, it is also the baseline condition against which the action alternatives are compared.

Elk Population Reduction

This alternative includes no actions to specifically control elk population numbers or actively manage the elk population within Rocky Mountain National Park. Instead, this alternative relies on forage availability, which is driven by weather, supplemented by hunting outside the park to control population size.

Ecosystem simulation modeling (Coughenour 2002) predicts that by continuing current management under this alternative, the population would range between 2,200 to 3,100 elk. This modeling assumed no significant development in the area and that all elk remain in study area. It also did not incorporate the potential for weather events that could affect the populations. As such, the population size could rise above or drop below this range due to variables such as weather and emigration or immigration of elk, either permanently or temporarily.

Elk Distribution

Under Alternative 1, no management actions would be taken to redistribute elk from areas where they concentrate on the elk range or to encourage migration to the primary summer range by elk that stay on the core winter range in the park during the summer. Under this alternative, without management actions to redistribute elk, the densities of elk, described in the "Purpose and Need for Action" chapter of this plan/EIS, are not expected to change over time.

Vegetation Management

Under this alternative, vegetation on the elk range, particularly willow and aspen, would not be protected from elk herbivory, and no measures would be employed to maintain or restore areas. Herbivory of aspen, willow, and upland herbaceous (grassland) communities would be expected to continue at a high level in localized areas of the elk range where elk would continue to concentrate at high densities and would continue to be less migratory.

Current Monitoring

The National Park Service currently monitors the elk population size, sex and age structure, and general distribution in the park. The Colorado Division of Wildlife monitors these same factors outside the park. Over the past decade, studies conducted in the park have assessed the status of vegetation conditions, beaver populations, and visitor attitudes and beliefs, but no routine monitoring is conducted.

One annual survey is conducted each winter over several days to count and classify elk, which provides information on the sex and age of the animals in the population by counting the number of calves and adult and yearling males and females. The National Park Service conducts ground surveys for three consecutive days inside the park on five routes and outside the park on seven routes. An aerial survey is conducted concurrently over the park's five routes on the first day. The National Park Service conducts additional classification surveys (ground) several times per

winter. Annual population estimates for the park primary winter range are based on total counts using a sightability model that was developed for the park (Lubow et al. 2002). The National Park Service generates population size estimates outside the park using an established correction factor (Lubow et al. 2002).

The Colorado Division of Wildlife conducts winter classification surveys annually outside the park. These data are used in population models to estimate post-hunting season population size and structure in Game Management Unit 20. In recent years, sex and age ratios have been based on a ground survey in the Estes Valley conducted by Colorado Division of Wildlife staff.

Minimum Requirement / Minimum Tool Analysis

Under this alternative, implementation of specific elements of the alternative listed below would require a prior, written minimum tool analysis. Final determination of what methods would be used for site-specific actions to manage elk and vegetation would be further evaluated and determined when the National Park Service completes the minimum tool analysis prior to implementation of actions of this plan/EIS. For a detailed discussion of the minimum requirement process, refer to the "Wilderness Minimum Requirement / Minimum Tool Analysis" section in "Elements Common to All Alternatives."

The following actions of Alternative 1 would be subject to minimum requirement and minimum tool analysis prior to their use in wilderness areas.

The use of firearms to lethally remove elk or dart guns to anesthetize elk suspected of having chronic wasting disease.

The use of helicopters for annual monitoring of the elk population.

Education

The park provides some interpretive programs and literature. Volunteer groups cooperate with the interpretive division to disseminate information regarding the elk population and its role in the environment. Natural resource staff and interpretive staff conduct outreach programs at schools and community meetings, as well as for other groups within the region. Under Alternative 1, the current education program would continue into the future.

ELEMENTS COMMON TO ALL ACTION ALTERNATIVES

Elk Population Management

All action alternatives employ population size targets to guide management actions. Ecosystem simulation modeling predicted that under natural conditions (i.e., with predators present), the elk population size would fluctuate between 1,200 and 2,100 animals with 200 to 800 wintering inside the park and 1,000 to 1,300 wintering outside the park. Therefore, all action alternatives are intended to maintain a viable elk population within this range. The alternatives vary in defining where within this range, such as at the high or low end, the target population would be reduced to and maintained over the life of the plan. The description of each alternative provides the specific target population range and how the target population would be achieved and maintained. It should be noted that based on adaptive management, management actions to control the elk population would not be taken if the elk population size was within the range specified by each action alternative and vegetation objectives were being met.

Lethal reduction (culling) would be conducted in all action alternatives, at least in the early years, using NPS personnel and their authorized agents. See Appendix H for further discussion of culling and authorized agents. Lethal reduction could be conducted under all action alternatives at any time of day using noise suppressed weapons (weapons equipped with a silencing device), unsuppressed weapons, and/or darting with anesthesia followed by lethal injection. To mitigate impacts on visitor use of the park consideration would be given to the type of weapon used and the time of day actions were taken. For example, to reduce or eliminate impacts on visitor use of the park and to reduce elk dispersion, lethal reduction could be conducted by shooting at night from the ground using noise-suppressed weapons. Spotlighting could illuminate target elk. Night vision firearm scopes would be used with rifles, and laser sights would be used with shotguns. If performed during daylight, lethal reduction could be carried out in more remote areas or on a much smaller scale. Reductions of the population by shooting with unsuppressed weapons would be conducted to redistribute the population away from selected areas. Immobilization by dart, followed by lethal injection, could be used when animals are close to structures or other areas used by people and where the discharge of a shotgun or rifle would not be prudent.

Lethal reduction activities could occur at any time of year and it could vary by alternative dependent upon the number of elk that may need to be removed annually. However, most lethal reductions would likely occur between November and February to allow the greatest opportunity to reduce the park subpopulation. Lethal reductions would be performed to minimize the likelihood of ophan calves and to minimize visitor impacts.

The National Park Service would use specially trained National Park Service staff and their authorized agents to perform reduction activities under the alternatives. See Appendix H for further discussion of culling and authorized agents. NPS personnel and authorized agents would be certified in firearms training, specially trained in wildlife culling, and be required to pass a proficiency test in order to qualify to participate in lethal reduction (culling) activities. To mitigate or eliminate a risk to public health and safety during lethal reduction actions, highly trained personnel would make decisions based on an understanding of the capability and characteristics of various firearms and ammunition that could be used. Decisions for type of firearm and ammunition to be used would be made on a case-by-case basis in terms of the backdrop, how far the round might carry, and the type and extent of visitor use in each particular area. Further mitigations and area closures would be employed as determined based on this evaluation. Mitigation could also include use of subsonic ammunition, which has a shorter range

than conventional rounds, and shooting from elevated stands, which can establish shooting lanes and reduce the distance bullets could travel via backstops. Spotters could be used to help ensure that the area is clear of people and to prevent individuals from entering the area during lethal reduction activities.

The alternatives may involve the use of authorized agents to conduct various management actions depending on cost, efficiency, and effectiveness. If contractors are used as authorized agents, in addition to other federal contracting requirements, for implementing this plan, a contractor is recognized as a fully insured business entity, nonprofit group, or other government agency engaged in wildlife management activities that include trapping, immobilization chemical euthanasia, or other lethal removal. The contractor must possess all necessary permits.

To maximize efficiency by removing the fewest animals, the primary target would be adult female elk rather than males because by removing females, the calves that they would produce in the current year and future years would not be recruited into the population. Thus, the population would be reduced by the number of individual females removed plus the offspring that they would have produced during their breeding years.

However, population modeling predicted that removing only females produced population structures with unnaturally large proportions of males and calves. Therefore, under the action alternatives, some calves and male elk would be removed to ensure that a minimum of 15% of the population is adult females to ensure no risk of local population extinction (Hobbs and Bradford 2006) and to prevent the bull to cow ratio from exceeding 80 bulls per 100 cows. Modeled ratios for the park have predicted a population structure as high as 60 bulls to 100 cows, which included some effects of hunting. Therefore, a population structure of 80 bulls to 100 cows is considered reasonable for unhunted populations in national parks (Hobbs 2005).

Based on monitoring data of elk population size and demographics, determination of the number of elk to be removed or controlled each year under each action alternative would use an adaptive management approach. Determining the level of management actions for a particular year would involve analyzing the results on the population of the previous year's management actions in combination with population changes that may have occurred as a result of stochastic events such as a severe winter in areas adjacent to the park. The National Park Service would continue to collaborate with the Colorado Division of Wildlife to monitor the population and to determine annual management activities in terms of the locations, numbers, and timing of elk removal.

Under all action alternatives, the National Park Service would continue to encourage the cooperating agencies to consider taking further actions outside of the park in addition to public hunting to manage the larger town subpopulation that spend most of their time outside of the park. Additional actions outside the park to reduce the elk population size and densities would reduce the need for management actions inside the park or reduce the intensity and frequency at which actions would be taken in the park.

Vegetation Management

Under all action alternatives there may be the use of fences as described in the alternative descriptions. Under all action alternatives, monitoring of vegetation communities would provide the information necessary to determine how many acres of willow or aspen on the primary elk range need to be protected. Similarly, monitoring data would provide the information necessary to determine when fences can be removed once communities are restored.

Aspen in particular could be fenced to maintain the aspen clone on the elk range. Currently there is debate about the historical establishment of aspen on the elk range. There is no sound evidence

that aspen were present on the elk winter range prior to elk extirpation by 1880 (Monello et al. 2005), but best available information indicates that aspen have been present in most of their current locations for hundreds of years (Monello et al. 2005). Additionally, studies have documented aspen establishment during periods when large elk populations of over five hundred animals were present (Olmsted 1979, W. Baker et al. 1997), such as before 1880. In addition, modeling predicts that aspen can regenerate, depending on the elk density and amount of time elk spent feeding in the aspen stands (Weisberg and Coughenour 2003). However, there may have been no aspen clones in the park on the elk winter range prior to elk extirpation. Other modeling has indicated that almost any population size of elk in the park can prevent aspen cohort establishment, and that current stands are primarily a result of aspen expansion while elk were extirpated from the area (Coughenour 2002). However, until further research can refute the hypothesis that the presence of aspen is not a result of elk extirpation, the park would manage aspen on the elk range as a natural component in those areas.

Selected fence designs, as determined through continuing coordination with U.S. Department of Agriculture Wildlife Services and the National Wildlife Research Center, would allow the greatest access to fenced areas by species such as deer, black bear, and smaller animals, but would prevent use of the area by larger animals such as elk and moose. Fence options include the use of wooden and/or wire fence in a rail or page-wire fence design with a gap in the bottom. Fences would also be designed with gates to allow for public access to areas to the extent possible. Which fence designs are used would depend on the location and the potential effects on wilderness, the viewshed, and movement of other wildlife species. Informal visitor surveys would assess the effects of fences on the visitor experience, and monitoring would assess the effects on other wildlife species. These factors would be used to evaluate future fencing types and locations and to minimize impacts on other resources. Installation of fences in locations away from roadsides may involve helicopters to transport materials. In wilderness, the locations and type of fence used, the method of transportation to remote locations, and the equipment used to install the fences would be determined based on a minimum requirement and minimum tool analysis. For a detailed discussion of the minimum requirement process, refer to the "Elements Common to All Action Alternatives" section titled, "Wilderness Minimum Requirement / Minimum Tool Analysis."

Once an area of aspen or willow was adequately protected from elk herbivory, (aspen are tall enough to withstand browsing pressures and still reproduce) or when elk density, numbers, and frequency of browsing (offtake) are low enough, as indicated in the "Monitoring and Data Collection" section, willow cuttings, mechanical thinning or removal, or prescribed fire could be used to facilitate regeneration of vegetation on the elk range if needed. Prescribed fire or mechanical methods could remove dead material or stimulate new growth in target aspen and willow communities. Because willow is particularly adept at rooting from cuttings if adequate water is present, planting of willow cuttings could support restoration of willow in areas with suitable hydrologic conditions, as in riparian areas.

Once willow vegetation is restored to an acceptable level, beavers would be expected to increase and recolonize riparian areas on the elk range. Approximately 10 acres or more of tall willow would need to be recovered to support a beaver colony indefinitely (B. Baker et al. 2003). If natural recolonization by beavers does not occur, the National Park Service would reintroduce beavers to main drainages that maintain 10 acres of tall willow for two years.

Adaptive Management

Monitoring and evaluation are crucial in determining whether management actions are achieving objectives. For instance, if elk numbers and distribution continue to show unacceptable effects on

vegetation, different management actions may be necessary to further reduce the abundance or density of the population, change the distribution of elk, or protect vegetation. This process of using information as it becomes available to alter management actions is called adaptive management. Adaptive management is an iterative process that requires selecting and implementing management actions, careful monitoring, comparing results with objectives, and using feedback to make future management decisions.

This process recognizes the importance of continually improving management techniques through flexibility and adaptation instead of adhering rigidly to a standard set of management actions. These alterations may include adjusting the number of elk removed, the number of acres fenced or the configuration of the fences, the frequency or location of redistribution activities, or releasing wolves. Any adjustment in management actions would be made within the framework of the alternative. For example, to reduce impacts on visitors and wilderness, Alternatives 2 and 5 focus on reducing the elk population and increasing elk distribution without the use of fences, so the use of willow fences would be an inappropriate adaptive management action within the context of those alternatives. Alternatives 3 and 4, which maintain the elk population at a higher level, involve the use of willow and aspen fences and redistribution techniques to protect vegetation. Adaptive management actions that would be appropriate within the framework of these alternatives would increase redistribution actions, including aversive conditioning, use of unsuppressed (noisy) weapons, and herding. Increased use of fences would also be appropriate within the constraints of the alternatives.

Each action alternative in this plan/EIS employs an adaptive management element involving monitoring and evaluation. Therefore, although each alternative employs a set of specific management techniques, some of those actions may change as a result of adaptive management.

Under this elk and vegetation management plan/EIS, seven steps would be followed when applying an adaptive management approach:

1. Collect baseline data. Existing conditions would be measured to establish a set of baseline conditions. The current conditions are described in the "Affected Environment" chapter.

2. Establish desired future conditions for the elk population. The park would manage for an elk population that is within the plan's target objective for size, density, and distribution. These objectives also define the desired conditions, which in the case of the elk population represent long-range goals.

3. Establish desired future conditions for vegetation. The park would manage the elk population based on the effects elk have on the vegetation, and vegetation would be monitored to determine whether management actions to reduce and distribute elk and to protect vegetation are successful. The effects of actions would be measured against established desired future conditions established for aspen, riparian montane willow, and upland herbaceous vegetation. Desired future conditions for vegetation are those target conditions indicating that the recovery of vegetation has been successfully achieved. The desired future conditions represent long-range goals for vegetation on the elk range that extend beyond the planning period of this plan/EIS.

4. Apply the management action. The elk population size and distribution and the vegetation recovery would be achieved by lethal reduction, fertility control, wolves, fencing, distribution techniques, release of wolves, or a combination of methods within the context of the alternative. To further enhance vegetation recovery, additional methods such as beaver reintroduction, planting of willow cuttings, and prescribed fire or mechanical

thinning of vegetation would be implemented after determining that vegetation was protected sufficiently from the effects of elk herbivory.

5. Monitor the effectiveness of the management actions. Monitoring would determine whether vegetation was recovering to levels defined in the management objectives and in the indicators and thresholds of vegetation conditions defined in "Monitoring and Data Collection" section below; whether the method(s) used were successfully reducing and maintaining the elk population size within the target population range defined under each alternative; and whether distribution objectives were being met. Data collected regarding the elk population size and vegetation response would be incorporated into the ecosystem simulation model to evaluate the progress being made toward meeting the objectives. This ecosystem simulation model and the elk population model would be used throughout the life of the plan to adjust the level of management actions within the framework of each alternative as needed to allow continued progress toward meeting the objectives.

   If progress towards meeting the management objectives does not occur within a reasonable time as indicated by vegetation condition thresholds, then different method(s) would be employed. If the management actions work effectively and meet thresholds, the National Park Service would continue to employ those methods. Each alternative describes what actions may be employed to replace or enhance the initial management actions. For instance, in Alternatives 3 and 4, if distribution techniques do not reduce impacts on vegetation to a level allowing recovery, then additional fencing may be installed.

6. Perform general surveillance for effects of the management actions on other resources in the project area to determine the effects of the methods. Surveys would show whether the management actions were having an unacceptable effect on native vegetation, other wildlife, sensitive species, or visitor use and experience.

7. If surveillance indicates that acceptable levels of impact on other resources have been exceeded, reconsider management actions. For example, if management actions to reduce the elk population have impacts on visitor experience that exceed those predicted in this plan/EIS, additional mitigation measures may minimize the effect or the management action may be changed within the context of the alternative. If dispersion activities in an area adversely affect visitors beyond acceptable levels, those actions may be stopped, the time of day they take place may change, or fencing may instead be installed in these areas to protect vegetation.

Adaptive management combines the advantages of the scientific method with the flexibility to address the human and technical complexities inherent in managing complex environmental issues. The goal is to give policy makers a better framework for applying scientific principles to complex environmental decisions (Wall 2004).

Monitoring and Data Collection

The effectiveness of specific management actions and resource conditions would be monitored through the 20-year life of the plan. This information would be used to adapt management actions as needed to meet plan objectives. Monitoring would be conducted in the short and long term on geographic scales ranging from site-specific to landscape. The frequency of monitoring actions would be high in early years and may decrease later if less frequent data collection is found to be sufficient. Monitoring would be used for several purposes:

1. To determine if management actions need to be altered (Are thresholds being met? Are specific techniques successful?).
2. To gather data needed for population modeling that would guide annual removal or treatment rates.
3. To gather data to improve the predictive capability of the ecosystem simulation model.
4. To determine educational needs based on visitor response to management actions.

The following would be monitored under all action alternatives:

Elk Population Size, Composition, and Distribution

The elk population size, composition, and distribution would be monitored using multiple population surveys each year. Surveys would be conducted on both primary winter and summer ranges to provide information to determine annual reduction and/or treatment targets. A population model would help determine specific targets needed each year to meet the reduction timeframe specified for each alternative. The model would be updated annually to incorporate new data and to account for observed density dependant responses in the population. For alternatives that include a maintenance phase (Alternatives 2 and 5), reduction would be adjusted as needed to maintain a population size within the target range for that alternative. Radio telemetry could be used to improve the efficiency of summer reductions by providing information on subpopulation distribution. Reductions would be distributed between males and females to maintain a gender structure that does not exceed 80 bulls per 100 cows while minimizing the number of animals killed.

The National Park Service would conduct surveys in the park and in the Estes Valley as described in Alternative 1; however, they would be conducted several times per winter. In addition, mark-resight surveys could be conducted to revise the correction factor for ground surveys as needed to incorporate changes in elk distribution.

The Colorado Division of Wildlife would continue to count and classify elk using a combination of aerial and ground surveys, followed by population modeling to estimate the population size for Game Management Unit 20. The Colorado Division of Wildlife would also continue to monitor harvest results for Game Management Unit 20. These data would be incorporated into the process of determining population reduction or treatment needs in the park each year.

On the primary summer range, the National Park Service would conduct a combination of aerial and ground surveys to count and classify elk. Population size could be estimated from a single summer count based on corrections derived from the results of multiple observers (Lubow 2005). This information would be used to fine tune reduction or treatment targets for the summer and fall reduction or treatment time periods.

Elk distribution would be recorded during annual aerial surveys in the park, and population density across the primary winter range would be calculated based on grids with a 100-meter cell size and a 3,000-meter search radius using the ArcGIS density calculation, consistent with methods used to determine baseline conditions (Singer et al. 2002). Ground surveys would be conducted weekly to monthly to ensure that distribution during aerial surveys is consistent with general winter distributions. Target densities in unfenced willow communities would be maintained below about 83 elk/mile^2 to maintain willow growth at about 60% of maximum levels (Singer et al. 2002). If monitoring of vegetation response indicates that this upper threshold is too high, then elk densities would be lowered to meet objectives.

From late June through early August, weekly ground surveys would monitor summer use in the core winter range in the park. Herding during that period would direct elk off the primary winter range toward the primary summer range.

To determine the efficacy of the redistribution methods, elk distribution would be monitored directly both for short-term distribution response at the time of any active elk management (e.g., lethal control, fertility control, herding, aversive conditioning, high wolf use areas) and for longer-term distribution responses in site-specific locations at random times. Vegetation consumption (offtake) would also be measured to indirectly monitor elk use in areas subject to specific management actions (see "Vegetation Structure, Regeneration, and Cover" section below).

The broad extent of the elk distribution across the primary winter and summer ranges would be monitored annually based on a combination of all location data collected during aerial and ground surveys conducted by the National Park Service and Colorado Division of Wildlife inside and outside the park. Outside the currently designated ranges, observations of any marked animals or tracks through snow would be used to indicate any range expansion. Radio telemetry could be used periodically as needed to provide more detailed information on elk movements and distribution.

Vegetation Structure, Regeneration, and Cover

Monitoring of vegetation would be limited to aspen, willow, and herbaceous vegetation types within the park elk range because these are most closely linked with elk herbivory. For example, any monitoring of upland shrubs (which are expected to benefit from lowered elk herbivory but are also browsed by mule deer; see Chapters 3 and 4) would not be associated with this plan.

The monitoring protocols would be designed in an experimental context to yield measurable results to show the level of improvement of vegetation structure, regeneration, or cover. Examples of design considerations are outlined by Zeigenfuss et al. (2001) and Binkley et al. (2001) in the Rocky Mountain National Park long-term monitoring program (Stohlgren et al. 2001b). Collection of baseline data would occur before any management actions are taken.

Table 2.1 describes the indicators that would be monitored for each vegetation category and the thresholds being evaluated to determine if management actions are successful or if actions would need to be altered to meet management objectives and vegetation desired future conditions.

Aspen

As a result of monitoring the indicators defined in Table 2.1, management actions would be adjusted to ensure that progress is made toward achieving desired future conditions. The desired future condition of aspen on the elk range would be a higher diversity of age classes, which would be expressed in two ways:

1. The distribution of stem diameters should reflect many (~75%) small diameters stems, some (~20%) medium diameters stems, and few (~5%) large diameters stems (Dan Binkley, Colorado State University, unpublished data). This would be measured as stems/acre plotted against diameter at breast height.
2. At least 45% of stands on the primary elk winter range and in the Kawuneeche Valley should have developed a regeneration cohort as seen in non-core winter range areas inside the park (Suzuki et al. 1999). This would mean that 45% or more of the stands in these areas should experience 1-2 regeneration events each decade.

TABLE 2.1: VEGETATION INDICATORS AND THRESHOLDS

Vegetation Category	Indicator	Threshold
Aspen	Number of stems/acre	Every 5 years the number of stems/acre reaching 10 years of age would be measured with an increase toward 45% of all winter range stands regenerating within each decade (Binkley et al. 2001 in Stohlgren et al. 2001b, Suzuki et al. 1999).
Riparian Montane Willow	Consumption/offtake	The annual consumption/offtake should not be greater than 27% averaged across all sites using estimation methods consistent with Singer et al. (2002).
	Percent cover	Percent cover increases toward the desired condition throughout the 20 year time period.
	Structure	Willow heights and stem densities on the primary winter range should increase 20% over the 20 years of the plan.
Upland herbaceous	Consumption/offtake	Annual consumption/offtake should not be greater than 59% averaged across sites (Singer et al. 2002), but at no point would more than 1% of sites be consumed at 80 to 100% offtake and no more than 15% of sites would be consumed at 50 to 80% offtake during the first 10 years and no more than 8% of sites thereafter (Coughenour 2002).

Such stand-level regeneration would be measured every 5 years by height (stems/acre between 1.5 and 2.5 m in height), aging of increment cores (stems/acre < 10 years of age), stem diameter at breast height, and stem density (stems/acre). In addition, overstory aspen mortality and diversity of age classes would be monitored.

Riparian Montane Willow

Given complete restoration of willow and hydrologic conditions the desired future condition of riparian montane willow is up to 70% willow cover within suitable riparian habitat on the primary winter range. The long-term desired condition could not be met within the 20-year period of this plan/EIS. However, within the 20-year life of the plan there should be an increase in the number of willow stands that are reaching a height beyond the reach of elk browsing and a progressive increase in percent cover of willow on the elk range to at least 10% greater than current conditions, indicating progress toward the overall desired condition.

Annual measurements of consumption/offtake would be taken. Percent cover and measurements of vegetation structure (height, canopy volume, and stem density) would be measured at least every 5 years. Percent cover would be monitored using a combination of remote sensing (aerial photography and/or satellite imagery) and ground measurements.

Upland Herbaceous

The desired condition for upland herbaceous vegetation (grasses) on the elk range would be an increase in the diversity of grazing levels so that not all areas are heavily grazed, but at no point should there be more than 1% of sites consumed at greater than 80% offtake and no more than 15% of sites consumed at 50 to 80% offtake (Coughenour 2002). Consumption/offtake would be measured annually.

Beaver Populations

In the past, beaver activity helped maintain higher water levels in many of the streams on the elk range, encouraging and nurturing willow growth. Water levels could be returned to their former levels to some degree by the natural colonization or the reintroduction of beavers. Therefore, the status of beaver populations would be monitored in riparian areas on the elk range. Winter ground surveys would help determine presence or absence and trends of current beaver activity (e.g., recently maintained dams or lodges, active bank dens, food caches) throughout the survey area, both inside and outside fences. The influence of beaver on surface water conditions would be determined using aerial photography at five-year intervals in conjunction with plant cover surveys.

Under the action alternatives, if beaver have not naturally recolonized areas on the elk range after sufficient willow recovery has occurred, beavers would be reintroduced to these areas. Based on findings that approximately 10 acres of tall willow could sustain one beaver colony on the primary winter range indefinitely Baker et al. 2003), at least 10 acres of restored willow sustained for two seasons would be needed prior to a reintroduction. Any reintroduced beavers would be monitored using radio telemetry to determine distribution, movements, habitat use, survival, and reproduction.

Natural Wolf Recolonization

As mentioned in "Elements Common to All Alternatives," park staff would consult with other federal and state agencies to keep apprised of any wolf activity in southern Wyoming, northeastern Utah, or northern Colorado and monitor the situation appropriately. In addition, management activities under the action alternatives would be altered if monitoring detected changes in the elk population size, composition, and distribution or in vegetation structure, regeneration, and cover as a result of wolf recolonization. For example, if elk were being effectively distributed by naturally recolonized wolves, aversive conditioning of elk would cease.

Visitor Response to Management Actions

Visitor response to management actions would be monitored informally by park staff who have regular contact with visitors as well as through general written comments from visitors. If appropriate approvals are obtained, formal visitor surveys asking opinions of elk and vegetation management activities would also be conducted periodically over the life of the 20-year plan, depending on funding availability. This information would help identify educational needs of the public to further understand the elk and vegetation management plan.

Humane Treatment

All action alternatives involve the direct management of individual animals, ranging from remote delivery of fertility control agents to live capture and lethal removal. These management

activities would be conducted in a manner that minimizes stress, pain, and suffering. Lethal removals using firearms would be conducted by NPS personnel and authorized agents that would be certified in firearms training, specially trained in wildlife culling, and be required to pass a proficiency test in order to qualify to participate in lethal reduction (culling) activities. Use of remote delivery systems for fertility control or anesthetizing (e.g., dart guns, Biobullet® guns) would also be conducted by trained personnel under Director's Order 77-4.

Efforts would be made to deliver immediately lethal shots to target animals, and shooters would be required to complete NPS range qualifications. The National Park Service would use recommendations of the American Veterinary Medical Association (AVMA) for euthanasia of restrained elk (AVMA 2001). Under every alternative, the degree of human contact during all procedures that require handling of wild animals would be minimized, and in all alternatives, the National Park Service would "reduce pain and distress to the greatest extent possible during the taking of an animal's life" (AVMA 2001).

Distribution of Carcasses

Carcasses of all adult elk subject to lethal removal would be removed from the field to the extent possible, individually marked, sampled for chronic wasting disease, and as necessary stored in refrigerated trucks in the park until test results are available (typically 4 to 14 days). Due to the logistical constraints of removing a high number of carcasses or removing carcasses from remote locations, some carcasses may be left in the field and their heads removed to allow testing for chronic wasting disease.

A predetermined, small number of carcasses in which chronic wasting disease has not been detected and which were not subject to lethal injection may be returned to the field with a wide spatial distribution to approximate natural conditions expected with intact populations of native predators. If calves are lethally removed from the population, their carcasses could be left in the field, as chronic wasting disease has not been detected in free-ranging elk less than 18 months old. Overall, the number of carcasses left in the environment would reflect a natural state to the greatest extent possible.

Removal of carcasses from the field would be accomplished using techniques that would cause the least amount of impact on natural resources, wilderness, and visitor experience, such as removal on foot; using a litter or sled over frozen ground; on a horse, all-terrain vehicle, or truck; winching or dragging behind a horse, all-terrain vehicle, or truck; to facilitate removal from remote areas of the park. In general, helicopters would not be used to remove carcasses except from remote locations if determined necessary due to disease management concerns. Due to concerns in wilderness, preference would be given to non-motorized removal techniques to the extent possible. The final determination of what method would be used to remove carcasses from the field would be determined when the National Park Service completes the minimum tool analysis prior to any site-specific action as part of this plan/EIS. Refer to the "Wilderness Minimum Requirement / Minimum Tool Analysis" section below for further detail on this process. All carcasses and carcass parts would be transported according to all state and federal laws and regulations regarding transport of elk carcasses and parts from areas with known chronic wasting disease.

To the extent possible the National Park Service would donate carcasses and/or meat from elk in which chronic wasting disease is not detected and that were not killed using sedative agents or euthanasia drugs through an organized program to eligible recipients, including members of tribes, based on informed consent and pursuant to applicable public health guidelines. Donation of meat would be based on the most current guidance provided by the NPS Public Health

Program (NPS 2006a). In this case, special attention would be given to proper, immediate field dressing and if necessary refrigeration. The National Park Service would also ensure that the required withdrawal period (the number of days that must elapse between drug administration and slaughter so that meat from a treated animal is fit for human consumption) had passed prior to donation of meat from elk that had been subject to fertility control.

Although all carcasses would be tested for chronic wasting disease before donation, chronic wasting disease tests are not sensitive enough to be thought of as a "food safety test." A "not detected" result does not guarantee that the animal does not have chronic wasting disease. Therefore, meat donation to individuals would only occur after gaining the individual's informed consent (NPS 2006a). According to the most current NPS Public Health Program guidance, gaining informed consent would involve at a minimum the following elements:

Inform individuals about the disease, its distribution, and its prevalence.

Inform the individuals about the chronic wasting disease testing that has occurred and the determination that the disease has not been detected in the carcasses.

Inform individuals about any potential human health risks as it is understood by science at that time.

In accordance with the current NPS public health program guidance (NPS 2006a) and the need to gain informed consent from individuals who may consume the meat, donations could not be made to food pantries, soup kitchens, or any entity that intends to redistribute the product. The required guidelines for meat donation may change in the future, and the National Park Service would adjust the disposition of carcasses accordingly.

The National Park Service would identify interested organizations, agencies, and /or tribes with whom to partner in a meat donation program in order to defer the high cost of processing and packaging the meat.

Any remaining carcasses in which chronic wasting disease has not been detected and that can not be donated would be landfilled. This is expected to be a limited number of carcasses. Those that have tested positive for chronic wasting disease would be incinerated or chemically digested at facilities outside the park.

Field dressing procedures and carcass handling to minimize exposure to chronic wasting disease infectious material would be followed at all times in accordance with state wildlife management guidelines.

Opportunistic Research Activities

Because the elk population would be subjected to management under all action alternatives, the National Park Service would take the opportunity to conduct a research study that could benefit management of elk in the future. In the first few years of elk management, the National Park Service would evaluate a rectal biopsy procedure that would serve as a preclinical diagnostic test for chronic wasting disease in live elk. In addition, the National Park Service would, contingent on availability, evaluate the effectiveness of a fertility control agent that would last for multiple years and would require a single treatment without the need for a booster shot in a wild and free-ranging elk population. During the first year of implementation of the elk management plan, up to 120 elk would be anesthetized using ground darting methods, and a biopsy of the rectal mucosa tissue would be taken and samples sent to a veterinary diagnostic laboratory for testing for chronic wasting disease. While the elk were under anesthesia, a fertility control agent, GonaCon™, would be administered to at least half of the female elk via hand injection to

evaluate the effectiveness of a multi-year, single contraceptive agent. Detailed information about GonaCon™ can be found in the description of Alternative 4 in this chapter. If GonaCon™ is not commercially available at study initiation, the National Park Service would collaborate with the National Wildlife Research Center to apply the agent under research authority. Blood samples would be taken from all animals to address any needs for subsequent information or diagnostic testing. All animals would be fitted with a radio-transmitter collar with a unique visual identifier.

Any animals that test positive as a result of the biopsy test would be located via radio telemetry and removed from the population via methods associated with the action alternatives. These animals removed would contribute to the annual population reduction target associated with the elk management actions.

In the second year of the study, annual removal activities to reduce the size of the population would ideally include about one-third of the radio-collared female elk that were subject to the fertility control agent and chronic wasting disease live test to assess the pregnancy and chronic wasting disease status of the elk. In the third year of study, another one-third of the remaining collared female elk would be removed as part of the population reduction activities, and these elk would be processed to assess pregnancy and chronic wasting disease status. In the fourth year of the study, the final third of the collared female elk would be removed and their pregnancy and chronic wasting disease status would be assessed.

Test animals would be lethally removed from the population over the four-year study. Elk would be examined for the presence of chronic wasting disease in the tissue and for any long-term effects of the original biopsy. The rectal tissue results would be correlated with the results of brain tissue samples to evaluate the efficacy of the rectal mucosa tissue biopsy test.

The rectal mucosa biopsy test, although applied in the field, does not provide immediate test results for the presence of chronic wasting disease. The application of the biopsy test in the management of the elk in the future is unknown. However, if in the future it is logistically and economically feasible to apply this or other diagnostic test within the framework of an action alternative, the National Park Service would selectively remove elk that test positive for the disease in an effort to reach annual population reduction targets. Knowledge and information gained from this study could contribute to the advancement of testing for chronic wasting disease with the goal of eventually leading to a test that provides immediate field results.

Education

The methods by which the park educates the public would be as described under Alternative 1. However, under all action alternatives, public education efforts would be enhanced to provide additional information about elk and their role in the Rocky Mountain ecosystem. In addition, educational materials would be developed to inform and increase public understanding of the management actions taking place in the park and the effects these actions have on vegetation, other wildlife, and visitors. Enhancements to the education program within the park could include any or all of the following:

Improved interpretive contacts and programs would detail the resource issues, management plan selected, monitoring program, and results and status of the resource.

Literature and brochures would also be developed and provided to the public at visitor centers, entrance stations, and community events.

A website dedicated to the management plan would be developed describing the information above, and, as information is collected, the website would be updated with results of field surveys.

Outreach programs to schools, groups, and community organizations would be tailored to discuss elk and vegetation management within the park.

Estimated Costs

The estimated one time infrastructure and annual costs of each action alternative are provided in the "Summary of Alternative Elements" table at the end of this chapter. A detailed description of the cost for each action alternative is provided in Appendix B.

The cost of each alternative was derived from multiple sources. Direct professional estimates were provided by staff from the National Park Service and the U.S. Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services Division for costs associated with lethal reduction, wolf release, chronic wasting disease testing, monitoring, education/interpretation, and aversion methods. Comparable costs were derived from literature sources and subject matter experts for fences, fertility control, and carcass disposal.

Cost estimates for the components of the alternatives include capital costs that occur once during the project as well as annual or recurring costs that are incurred throughout the life of the project.

The alternatives involve the use of contractors to conduct actions associated with intensive lethal reduction activities in the first four years of Alternative 2, fertility control activities in Alternative 4, and the lethal reduction of elk and release of wolves in Alternative 5. These have been estimated in the costs of each respective alternative. In addition to other federal contracting requirements, for implementing this plan, a contractor is recognized as a fully insured business entity, nonprofit group, or other government agency engaged in wildlife management activities that include trapping, immobilization, chemical euthanasia, or other lethal removal. The contractor must possess all necessary permits. Cost, efficiency, and effectiveness would be the factors that determine when supplemental personnel are needed.

ALTERNATIVE 2

Under Alternative 2, the elk population would be reduced to a low population target (1,200 to 1,700 elk: 200 to 400 park subpopulation; 1,000 to 1,300 town subpopulation) using lethal means (culling) implemented by NPS personnel and their authorized agents. See Appendix H for further discussion of culling and authorized agents. Inside the park, between 200 and 700 elk would be lethally removed annually within the first four years of the plan to bring the population to the target size as quickly as logistically possible. To maintain the target population range, 25 to 150 elk would be removed annually over the remaining 16 years of the plan. To the extent possible elk carcasses and/or meat resulting from these actions would be donated through an organized program to eligible recipients including members of tribes based on informed consent and pursuant to applicable public health guidelines. Under this alternative it is expected that 160 acres of aspen habitat could be fenced. Use of distribution techniques would also be required to meet vegetation objectives.

Elk Population Reduction

Under this alternative, between 200 and 700 elk would be lethally removed annually in the first four years and between 25 to 150 elk would be removed annually over the remaining 16 years to maintain the population size. The number of elk to be removed each year would be determined based on population estimates and harvest by hunters outside the park. Lethal reduction inside the park would be conducted by NPS personnel and their authorized agents who would be certified in firearms training, specially trained in wildlife culling, and be required to pass a proficiency test in order to qualify to participate in culling activities. Lethal reduction actions would be conducted in a manner that would minimize impacts on visitor use and experience. Mitigations would include varying the type of weapon or the times of day when actions occur.

A temporary capture facility, such as a corral trap, could be used inside the park if needed to reach population reduction targets, particularly during the intensive lethal reduction of the first four years. Areas not frequented by the public, such as Little Horseshoe Park, would provide the preferred locations for a temporary capture facility. Elk could be attracted to the facility using bait. Bait could attract other species of wildlife. Concentrating bighorn sheep could increase the potential for disease spread among the population. To mitigate this concern, the baiting locations would not be placed in areas known to be frequented by bighorn sheep, and lethal elk reduction actions would be implemented as quickly as possible to minimize the number of days that bait would be present in the environment. Alternatively, trained herding dogs, riders on horseback, people on foot with noisemakers or visual devices could direct elk to the facility. Helicopters could be used adaptively for herding elk to a capture facility if monitoring indicates other methods are not effective. Following capture, American Veterinary Medicine Association-approved lethal removal methods such as shooting, penetrating captive bolt, or lethal injection would be used onsite. Every effort would be made to "reduce pain and distress to the greatest extent possible during the taking of an animal's life" (AVMA 2001).

Adult female elk would be the preferred target for lethal reduction because reducing the number of adult females in the population more effectively reduces the potential for population growth. However, some males and calves would also be removed to maintain at least 15% of the population as adult females and to prevent the bull to cow ratio from exceeding 80 bulls per 100 cows. In addition, individual elk could be targeted to simulate wolf predation (i.e., to take elk in poor physical condition in preference to healthy elk, calves in preference to cows, cows in preference to bulls). During capture operations, individuals not meeting age or gender criteria

could be released. To reduce the potential for chronic wasting disease transmission while in the capture facility, the National Park Service would work quickly to release those animals that would not be subject to lethal control.

Lethal reduction activities could occur at any time of year. However, most lethal reductions would likely occur between November and February to allow the greatest opportunity to reduce the park subpopulation. Lethal reductions would be performed to minimize the likelihood of ophan calves and to minimize visitor impacts. Lethal reduction could be done anywhere in the park where logistically feasible. Particular emphasis would be given to areas of aspen on the primary elk range and areas of suitable willow habitat such as on the core winter range, where willow communities have the greatest need for protection from browsing pressure and where beavers influenced riparian habitat in the past.

Elk Distribution

Elk would still be expected to use the primary winter and summer ranges, although in greatly reduced numbers and lower densities. Population reduction activities using noise-suppressed weapons would not be expected to disperse elk long distances (i.e., out of the park), and only local elk movement may result as carcasses are being removed. Lethal reduction with unsuppressed weapons could disperse elk from areas of vegetation that are highly degraded, reducing browsing pressure. These activities would result in temporary dispersal of elk across short distances within the park while operations were ongoing and could deter elk foraging at other times. Small-scale reduction actions with unsuppressed weapons could also be used between late August and late November in the Kawuneeche Valley over a widespread area to facilitate the movement of elk to areas outside the park where they could be hunted. The long-term effects of suppressed and unsuppressed lethal reduction of elk redistribution are uncertain, and elk may avoid areas in the park for longer periods of time. They may also seek refuge in unhunted areas such as Estes Park and Grand Lake.

Aversive conditioning and herding would prevent or reverse habituation of elk and would disperse elk from sensitive areas on the elk range to relieve browsing pressure on aspen and willow, especially when lethal reduction activities are not taking place. Use of aversive conditioning and herding may increase during the maintenance phase of the plan due to the decreased degree of lethal reduction activity. Aversive conditioning could be used to encourage localized movements and to cause elk to avoid areas or to move elk from the Kawuneeche Valley to areas outside the park where they could be hunted. Herding – the act of bringing individual animals together into a group, maintaining the group, and moving the group from place to place – could encourage the movement of elk from primary winter range areas to traditional use areas on the primary summer range. Aversive conditioning and herding in the park would include the use of rubber bullets, cracker shot, non-lethal projectile rounds, visual devises such as sticks with streamers, trained herding dogs, people on foot, or riders on horseback. If necessary, helicopters could be used adaptively during herding efforts if monitoring indicates other methods are not effective. Based on monitoring of vegetation condition, the frequency and intensity of redistribution methods could be increased as needed to disperse elk or move them to the primary summer range.

A study conducted in Banff National Park in Canada used predator-resembling aversive conditioning to imitate predation events so that elk redistribution reflected a more natural state. The study temporarily modified the behavior of human-habituated elk by increasing the distance that elk move and their wariness of humans (Kloppers et al. 2005). In this alternative, the change in the distribution of elk in response to lethal reduction actions with unsuppressed weapons, herding, or aversive conditioning (as well as fencing to protect aspen, which is discussed below)

would be monitored to determine the efficacy of the methods in achieving management objectives.

To the extent possible, redistribution actions would avoid and minimize potential adverse effects on sensitive species and other wildlife by restricting elk redistribution actions during known sensitive portions of species' life cycles or in sensitive locations (e.g., breeding or nesting seasons, migration corridors, nesting habitat).

If monitoring shows that management objectives are not being met, the National Park Service would consider release of wolves into the park to redistribute elk according to the process described in Alternative 5. Release would take place if opportunities were present to cooperate with adjacent land managers and the State of Colorado, and if supported by state and federal policy. The National Park Service would enter into discussion with the state to ensure consistency with state plans for managing wolves. The Colorado Division of Wildlife formed a multi-disciplinary working group that developed a wolf management plan, which was adopted by the Colorado Wildlife Commission in June 2005 to address management of wolves if they migrate into the state. In November 2005 the wolf working group was tasked to continue discussions through 2006, focusing on who should make the decision about potential reintroduction of wolves to Colorado and how to structure a compensation program. The National Park Service would continue to communicate with the wolf working group as their discussions progress and would cooperate with the state to ensure consistency with existing and any future wolf management plans.

As long as the gray wolf is a federally protected species, the National Park Service would need approval and applicable permits from the U.S. Fish and Wildlife Service to acquire, release, and manage wolves in the park. Permits would also be needed from individual states to allow transport across state lines and from the agency providing the source wolves. To implement the adaptive use of wolves under this alternative, the National Park Service would be required by the U.S. Fish and Wildlife Service to develop a detailed plan describing the process to transport, release, and manage wolves in the park. This more detailed plan would be subject to further NEPA compliance and further consultation with the U.S. Fish and Wildlife Service; this consultation would be deferred until determining that wolves would be needed. The National Park Service would continue to monitor the regional status of wolves as described in the "Elements Common to All Alternatives" section of this chapter and would continue to cooperate with other agencies on wolf-related issues.

Vegetation Management

Under this alternative, up to 160 acres of aspen habitat on the elk range could be fenced. Because this alternative reduces elk numbers to the lower end of the natural range of variation within the first four years of the plan and uses distribution techniques to reduce high concentrations of elk, temporary fences would be installed adaptively, based on vegetation response to elk management actions as indicated through the monitoring program. It is unlikely under this alternative that all aspen on the elk range would be fenced. The amount of fences that would be installed in the first 10 years of the plan would be limited to the extent possible to allow ample time to determine vegetation response to elk management actions and for further research to determine whether the presence of aspen in the elk range is part of the natural condition. However, the installation of fences could begin in the first year of the plan to allow monitoring vegetation response to management actions (e.g., control plots) as well as to provide protection from elk browsing.

The high level of elk population reduction in the early phase of the plan, followed by maintenance of the elk population size within the lower end of a natural range of variation in

subsequent years and the use of distribution methods to increase elk movements and decrease densities, would facilitate recovery of suitable willow habitat on the elk range to meet management objectives without the use of fences.

When vegetation receives adequate protection (aspen are tall enough to withstand browsing pressures and still reproduce) or when elk density, numbers, and frequency of browsing (offtake) are low enough, as indicated in the "Monitoring and Data Collection" section, the fences would be removed. Fences, however, may be in place for the remainder of the planning period or longer, depending on vegetation response.

Once an area was adequately protected from elk herbivory, willow cuttings or plantings, mechanical thinning or removal, prescribed fire, or the recolonization of beaver could be used to facilitate regeneration of vegetation on the elk range as described in "Elements Common to All Action Alternatives" section. The ability to use these restorative techniques, particularly in unfenced areas, would likely occur later in the planning process.

Distribution of Carcasses

The distribution of carcasses would be as described in the section "Elements Common to All Action Alternatives." To the extent possible elk carcasses and/or meat would be donated through an organized program to eligible recipients including members of tribes based on informed consent and pursuant to applicable public health guidelines. Based on logistical constraints of carcass removal, some carcasses may be left in the environment. The number of carcasses that may be left in the environment would reflect a natural state to the greatest extent possible.

Chronic Wasting Disease Prevalence Testing

All adult elk subject to lethal removal would either be removed from the field or the heads would be taken and tested for chronic wasting disease as described in "Elements Common to All Action Alternatives."

If a field test that provides immediate results becomes available to allow live testing for chronic wasting disease, elk corralled during population reduction activities would be immediately tested, and those testing positive for the disease could be preferentially removed to reach the target elk population number. Those elk in which chronic wasting disease has not been detected could be released if the annual number of elk to be removed from the population to meet management objectives has been reached.

Minimum Requirement / Minimum Tool Analysis

A programmatic analysis of elements of the alternative has been included in the minimum requirement analysis that is provided in Appendix G. Under this alternative, the elements listed below would require analysis through a minimum tool analysis which would be conducted prior to site-specific implementation of actions. For a detailed discussion of the minimum requirement process, refer to the "Wilderness Minimum Requirement / Minimum Tool Analysis" section in "Elements Common to All Alternatives."

The following actions of Alternative 2 have been evaluated in a minimum requirement analysis (see Appendix G) and would also be subject to a minimum tool analysis prior to their use in wilderness areas.

The use of helicopters for monitoring elk and transporting fence materials. Helicopters could also be used adaptively if necessary for herding elk and for removing carcasses from remote locations due to disease management concerns.

The use of a temporary capture facility to conduct lethal reduction actions, identification of appropriate locations for the facility, and transportation and erection of the facility.

The use of trained herding dogs to herd elk.

The use of all-terrain vehicles or trucks to remove carcasses.

The use of aversion techniques to disperse elk.

The use of fences to protect aspen and the use of equipment to transport and erect the fences. The use of prescribed burning, identification of appropriate locations for burns, and use of equipment necessary to conduct those burns.

The use of mechanical vegetation thinning or removal activities, identification of appropriate locations, and use of equipment necessary to conduct the actions.

ALTERNATIVE 3

Alternative 3, the preferred alternative, relies on gradual lethal reduction (culling) of elk by NPS personnel and their authorized agents to achieve a high target elk population ranging between 1,600 to 2,100 total elk (600 to 800 park subpopulation; 1,000 to 1,300 town subpopulation) by the end of the plan. See Appendix H for further discussion of culling and authorized agents. Inside the park, up to 200 elk would be removed annually over 20 years. Elk carcasses and/or meat resulting from these actions would be donated through an organized program to eligible recipients based on informed consent and pursuant to applicable public health guidelines. The higher elk population target under this alternative would require additional measures, including fences and distribution techniques, to meet vegetation objectives. Please see the "the Preferred Alternative" section at the end of this chapter for the rationale as to why this alternative was chosen as the preferred in this final plan/EIS.

Elk Population Reduction

Lethal reduction inside the park would be carried out under controlled conditions as described above for Alternative 2. The number of elk to be removed each year would be determined based on population estimates and harvest by hunters outside the park. Because of the lower number of animals removed each year, this alternative may not need a temporary capture facility. However, based on monitoring of the effectiveness of removal actions, a temporary capture facility may be used as an adaptive management tool in the future as described in Alternative 2.

Lethal reduction activities could occur at any time of year. However, most lethal reductions would be performed between November and February to allow the greatest opportunity to reduce the in park subpopulation. Lethal reductions would be performed to minimize the likelihood of ophan calves and to minimize visitor impacts.

The location of lethal reduction activities would be similar to those described in Alternative 2. Lethal reduction could be done anywhere on the elk range where logistically feasible. Particular emphasis, however, would be given to areas on the primary elk range of aspen and suitable willow habitat where willow communities have the greatest need for protection from browsing pressure and where beavers influenced riparian habitat in the past.

As logistical capabilities for using fertility control improve and longer-acting, multi-year drugs are developed, fertility control could be used as an adaptive management tool under this alternative to maintain and/or reduce the elk population size. The multi-year control agent would need to meet the requirements for use as described in Alternative 4. Implementation of fertility control activities to reduce and/or maintain the elk population would be as described in Alternative 4. To implement the adaptive use of fertility control agents in the future, the National Park Service would further consult with U.S. Fish and Wildlife Service, Colorado Division of Wildlife, and the public regarding details of that action and effects on federally threatened and endangered species.

Elk Distribution

Elk would still be expected to continue to use the primary winter and summer ranges but at moderately reduced numbers and densities. The dispersal effect on elk from the use of weapons during lethal reduction actions would be as described in Alternative 2. However, because of the lower number of animals removed in the first four years under Alternative 3, the frequency of lethal removal actions would be less, resulting in less dispersal from reduction actions during this

time period compared to Alternative 2. The potential for a higher number of animals to be removed in the last 16 years under this alternative could result in a greater frequency of reduction than under Alternative 2, resulting in increased dispersal as a result of lethal removal actions during these years. Lethal reduction activities would disperse elk while operations were occurring and may also deter elk foraging at other times of the year.

Methods to redistribute and herd elk would be the same as described in Alternative 2. Because of the higher target population level under this alternative, use of aversive conditioning and herding would be more frequent over the 20-year implementation period to reduce browsing pressure on the vegetation than under Alternative 2. The distribution response of elk as a result of redistribution techniques would be monitored to determine the efficacy of the methods used.

The National Park Service would consider release of wolves into the park as an adaptive management approach to redistribute elk according to the process described in Alternative 5, if monitoring indicates that management objectives are not being met. Release would take place if opportunities were present to cooperate with adjacent land managers and the State of Colorado, and if supported by state and federal policy. The process for use of wolves as an adaptive management tool would be the same as described in Alternative 2.

Vegetation Management

Under this alternative, fences would protect aspen and montane riparian willow on the primary elk range. The National Park Service would determine the need for fences based on monitoring the response of vegetation to reduced elk numbers, lethal reduction activities, and redistribution methods. Monitoring of vegetation communities would provide the information necessary to determine how many acres of willow or aspen on the primary elk range need to be protected. Similarly, monitoring data would provide the information necessary to determine when fences can be removed once communities are restored.

Under this alternative it is expected that 160 acres of aspen habitat on the elk range would be fenced. Because of the gradual reduction in the elk population size over time, it is expected that installation of fences would begin within the first five years of the plan. Once vegetation receives adequate protection (the aspen are tall enough to withstand browsing pressures and still reproduce) or when elk density, numbers, and frequency of browsing (offtake) are low enough as indicated in the "Monitoring and Data Collection" section, the fences would be removed.

Because of the higher elk population target compared to Alternative 2, fences would be needed to protect riparian willow communities. Due to the highly degraded condition of willow on the primary winter range, it is expected that 260 acres of suitable willow habitat on the primary winter range would be fenced. Compared to other action alternatives, this alternative involves the lowest level of elk management, and although redistribution methods would be used to protect willow on the elk range, at this time the success that could be achieved with elk redistribution techniques is uncertain. Therefore, to ensure that management objectives for willow are also met on the primary summer range, it is expected that 180 acres of suitable willow habitat on the primary summer range would be fenced under this alternative.

Fences would be installed at levels commensurate with elk numbers and distribution that result from lethal reduction and distribution activities. This would ensure that there is ample food available in areas outside the fences for the number of elk remaining in the population which would prevent mass emigration of elk from the park and prevent further degradation of vegetation outside fenced areas.

Once an area was adequately protected from elk herbivory, willow cutting plantings, mechanical thinning or removal, prescribed burning, or recolonization by beaver could facilitate regeneration of vegetation on the elk range as described in "Elements Common to All Action Alternatives." These restorative methods could be used earlier in the planning process in fenced areas due to the higher level of protection provided against elk herbivory.

Distribution of Carcasses

The distribution of carcasses would be as described in the "Elements Common to All Action Alternatives" section. To the extent possible elk carcasses and/or meat resulting from these actions would be donated through an organized program to eligible recipients including members of tribes based on informed consent and pursuant to applicable public health guidelines. Because of the low number of elk removed each year, the number of carcasses needing to be disposed of would be less than Alternative 2 in the first four years but slightly higher in the last 16 years. The number of carcasses that would potentially be left in the field would not exceed natural conditions.

Chronic Wasting Disease Prevalence Testing

All adult elk subject to lethal removal would either be removed entirely from the field or the heads would be taken and tested for chronic wasting disease. Over the life of the plan, the number of elk tested would be less than under Alternative 2, as the number of elk needing to be removed from the population would be less to reach and maintain a higher population target under this alternative.

If a field test that provides immediate results becomes available to allow live testing for chronic wasting disease, elk that are subject to anesthetization or that are corralled during population reduction activities would be immediately tested, and those testing positive for the disease would be preferentially removed to reach the target elk population number. Those elk in which chronic wasting disease has not been detected could be released if the annual number of elk to be removed from the population to meet management objectives has been reached.

Minimum Requirement / Minimum Tool Analysis

A programmatic analysis of elements of the alternative has been included in the minimum requirement analysis that is provided in Appendix G. Under this alternative, the elements listed below would require analysis through a minimum tool analysis which would be conducted prior to site-specific implementation of actions. For a detailed discussion of the minimum requirement process, refer to the "Wilderness Minimum Requirement / Minimum Tool Analysis" section in "Elements Common to All Alternatives."

The following actions of Alternative 3 have been evaluated in a minimum requirement analysis (see Appendix G) and would also be subject to a minimum tool analysis prior to their use in wilderness areas.

The use of firearms to lethally remove elk or dart guns to anesthetize elk.

The use of helicopters for monitoring elk and transporting fence materials. Although unlikely, helicopters could also be used adaptively if necessary for herding elk and for removing carcasses from remote locations due to disease management concerns.

The use of horses to herd elk or remove carcasses.

The use of trained herding dogs to herd elk.

The use of all-terrain vehicles or trucks to remove carcasses.

The use of aversion techniques to disperse elk.

The use of fences to protect aspen and suitable willow habitat and use of equipment to erect the fences.

The use of prescribed burning, identification of appropriate locations for burns, and use of equipment necessary to conduct those burns.

The use of mechanical thinning activities, identification of appropriate locations, and use of equipment necessary to conduct the actions.

ALTERNATIVE 4

Alternative 4 would emphasize treating cow elk with a fertility control agent to the greatest extent possible given technological and logistical capabilities. In addition, lethal reduction (culling) of elk by NPS personnel and their authorized agents would be needed each year to reach plan objectives. See Appendix H for further discussion of culling and authorized agents. The target elk population of 1,600 to 2,100 total elk (600 to 800 park subpopulation; 1,000 to 1,300 town subpopulation), which is on the higher end of the natural range of variation, would be achieved by the end of the 20-year plan. If using an agent that is effective for one year, up to 400 elk would need to be treated annually during the first four years of the plan and 200 for each of the remaining 16 years. When using a single-year fertility control agent, 80 to 150 elk would need to be lethally removed each year to reach plan objectives. For longer-lasting fertility control agents, either the number of elk treated or the number of elk lethally removed would be reduced. Elk carcasses and/or meat resulting from these actions would be donated through an organized program to eligible recipients including members of tribes based on informed consent and pursuant to applicable public health guidelines. Because of the higher elk population target under this alternative, additional measures, including fences and distribution techniques, would be required to meet vegetation objectives.

Elk Population Reduction

Fertility Control

Using fertility control agents, this alternative would reduce the number of calves born into the population each year, which would slowly contribute to the decline in elk population size. The use of fertility control agents to manage a free-ranging wildlife population has never been conducted. The National Park Service acknowledges that it may be difficult to control a high number of elk with fertility control, especially with the agents currently available, which last for only one breeding season. Therefore, lethal control (culling) by NPS staff and their authorized agents would also be needed to meet population targets.

Reduction of the elk population within the project area could be achieved in part using a single-year, multi-year, or lifetime duration fertility control agent. Using a single- or multi-year agent**,** a female elk may be treated multiple times during plan implementation; however, the female elk would resume full reproductive capability after the duration of the agent has expired. Fertility control administration would take place within park boundaries by certified NPS staff or contractors according to Director's Order 77-4: Pharmaceuticals for Wildlife. Best management practices for applying fertility control agents as described in Director's Order 77-4 and staff training would reduce safety risks associated with treating large numbers of animals. In addition, every effort would be made by staff to retrieve darts that have missed their target.

A lifetime fertility control agent would permanently prevent reproduction. No lifetime control agents currently available meet the established criteria for use on elk in the park (see "Requirements for Fertility Control Agents," below). However, if during the life of this plan such an agent becomes available, it could be used to meet and/or maintain the target population size.

Leuprolide acetate (referred to throughout the text as leuprolide), a single-year agent, has been tested in elk and found to cause infertility for one breeding season (Baker et al. 2002); it is currently available for use. It is estimated that this agent could logistically be administered to up to 400 cow elk per year in the first four years of the plan. Treatment would occur between

August and early September to prevent births in the following year. Elk would probably become more wary of management actions after the first four years of the plan, making treatment of a high number of elk logistically more difficult. Therefore, during the last 16 years of the plan 200 elk per year would probably be treated.

A potential multi-year reversible agent, GonaCon™, which has not been field tested or reported for use in free-ranging elk, could also be used in a small-scale investigation as described in the "Opportunistic Research Activities" section earlier in this chapter, treating approximately 60 elk until obtaining regulatory-approval. Using a potential multi-year agent such as GonaCon™, and assuming a three-year duration of drug effectiveness, the number of female elk needing treatment each year would probably be less than that described for a single-year agent, assuming similar lethal removal numbers. See "Potential Agents" section below for more information on leuprolide and GonaCon™.

Only female elk would be treated. By stopping reproduction in female elk, the calves that they would produce in the current and future years would not be recruited to the population. In addition, the treatment of males would be ineffective because one male can breed with many females. Therefore, the treatment of all dominant bulls, even if feasible, would not ensure that subordinate bulls would not then breed. The treatment of bulls would also likely lead to decreased rutting and breeding behavior.

Treatment with leuprolide could be done either by hand injection or by darting the elk assuming no withdrawal time. The preferred method for treatment with leuprolide would be by remote delivery of the agent and a short-term mark such as by paint ball to prevent multiple treatments within the same year. Although not harmful to the elk, it would be less efficient to re-treat already treated elk. If hand injection methods are used, elk would need to be captured as described in Alternative 2 and handled for treatment and marking.

At this time, single-year agents are only available to treat female adults. If a multi-year or permanent agent with no withdrawal period and with regulatory-approval or approved by a prescribing veterinarian for extra-label use becomes available and proves safe and effective on calves, female calves would be preferentially treated over female adults to eliminate the need for long-term marking. A short-term mark, as with a paint ball, would prevent multiple treatments of young-of-year individuals.

Treated elk would need to receive a readily recognizable long-term mark that warns individuals not to consume the meat if the elk was killed before the required withdrawal period had passed for a regulatory approved fertility control agent or immobilization drug, or if the fertility control agent was not regulatory-approved or approved by a prescribing veterinarian for extra-label use. For Food and Drug Administration (FDA) licensed drugs used according to label directions, the withdrawal period of an agent is identified on the label. For extra-label drug use, the period is determined by the prescribing veterinarian based on the best available scientific information. The preferred method of administering an agent that requires a long-term mark on the elk would be immobilization by dart followed by treatment and marking.

To treat large numbers of elk efficiently, a temporary capture facility could be used as an adaptive management tool inside the park. The location and details of the capture facility are the same as described in Alternative 2 except that bait would not be used and animals subject to fertility control would be released after treatment.

Long-term marking methods currently available include ear tags, freeze branding, passive transponders, and subcutaneous radio frequency tags. To balance the needs of monitoring treated individuals with that of reducing visual impacts, different marking methods may be employed as they become available.

Treatment activities could occur in any area of the park. However, treatment activities with agents needing to be administered during summer would mostly be completed on the primary summer range, while those agents needing to be administered during winter would be completed on the primary winter range. Treatment activities could occur during any time of day and at any time of year. The time of year for conducting treatment activities would depend largely on when the agent would be effective without unacceptable adverse effects on the elk. For example, if the agent was found to cause loss of fetuses when pregnant elk are treated, the timing would be adjusted based on best professional judgment to prevent treating pregnant elk.

Requirements for Treatment Agent

Several fertility control agents that might be effective for implementing this alternative are in development, and new agents may become available in the future. This section identifies the characteristics that any treatment agent must have before it is deemed acceptable for implementation in this alternative. As part of the adaptive management approach, an agent could be used experimentally under strict oversight, with use discontinued if it is found to be unacceptable for implementation.

Effective with a single treatment: The agent would effectively control fertility for the specific duration with a single dose. Elk in and around Rocky Mountain National Park are wild, free-ranging animals, and it would be impractical to capture the same individual more than once in a season for treatment. As shown with tule elk (*Cervus elaphus nannodes*) at Point Reyes National Seashore, porcine zona pellucida (PZP), a highly effective contraceptive, requires an initial treatment followed by a booster dose three weeks later; it is therefore considered unsatisfactory for fertility control in the free-ranging elk population in Rocky Mountain National Park.

At least 85% effective: Ideally, a fertility control agent would be effective in every treated animal. However, variability in the biological response to an agent may enable some individuals to remain fertile even after treatment. The lowest acceptable level of effectiveness that would enable the program to reach the target elk numbers would be 85%. An agent with lower effectiveness would require the treatment of a high number of females that would be logistically difficult to accomplish.

Appropriate approvals and certifications: Ideally, the agent would have regulatory approval for use in elk and would require no withdrawal period. Less optimally, it would be approved for use in an alternate species as an extra-label drug or approved for investigational purposes and would require no withdrawal period. If the agent was used for investigational purposes, the National Park Service or researcher would be required to obtain an investigational new animal drug exemption from the appropriate regulatory agency. This exemption requires specialized authorizations under a drug research project. All agents would need to be certified as safe for use in elk by the prescribing veterinarian. If the drug used has a required drug withdrawal period, all animals treated would be permanently marked to notify individuals who might harvest the animals not to consume the meat unless the established withdrawal period passed before slaughter.

Safe for treated animals: The agent would have no long-term effects on treated elk other than effective fertility control. This would include the absence of toxic, short-term reactions or debilitating, long-term effects that would increase mortality in the population. It also would not result in any genetic mutations that would interfere with the treated animal's life cycle or be passed on to subsequent generations if the fertility control was not successful. An agent would also not be used if it caused a loss of fetuses 60 days or older or if it were to cause any debilitating health problems to a developing fetus carried to term. A conservative estimate of

when fetuses would be 60 days or older would be after November 1 until June 15. To eliminate the chance of population loss, permanent sterility must not occur in more than 10% of treated elk when using a single- or multi-year reversible agent.

No recognizable behavioral effects: The fertility control agent would not result in recognizable behavioral effects. Some of the problems that would be avoided include the following:

> **Reduced courtship, rutting, and breeding behavior**. Watching and listening to bull elk during the fall breeding season is an important component of the visitor experience at Rocky Mountain National Park. Noticeable reduction in bulls' bugling, palpating, herding of cows, or challenges would adversely affect visitor experience. Reduced visitation would have a severe adverse effect on the local economy.
>
> In elk, pheromones, which are externally secreted chemicals that influence the physiology or behavior of other individuals of the same species, may trigger or enhance breeding-related behaviors, such as a bull collecting cows into a harem and defending that harem through such behaviors as bugling. If it altered release of pheromones, a fertility control agent could affect rutting and breeding behavior. Reduced pheromone release in some cow elk would be inconsequential if bulls continued natural current rutting and breeding behaviors without preference to treatment status.
>
> **Increased courtship, rutting, and breeding behavior**. PZP vaccine, although an effective contraceptive because it prevents pregnancy, caused prolonged rutting and breeding behavior in tule elk at Point Reyes National Seashore in California. If used in Rocky Mountain National Park, it would result in such behavior from September 15 to March 15. This behavior would be physically draining for the bulls, could increase elk-human conflicts such as collisions with vehicles, and would clearly be a recognizable behavioral change from natural current conditions.

Safe for non-target animals: The carcasses of dead elk serve as a food source for many other animals in the park. Some elk are killed and eaten by predators such as mountain lions and coyotes. Wild birds and mammals that feed on the elk carcasses include black bear, magpies, hawks, eagles, coyotes, and foxes. In areas close to human habitation, domestic cats and dogs may also feed on dead elk. Ideally, a fertility control agent must not have any known adverse effects on non-target animals that consume elk. These would include no toxicity, no change in fertility, and no genetic mutations that would interfere with life cycles or be passed on to subsequent generations. The long-term effects of agents on non-target animals are unknown. Based on an adaptive management approach, if additional information becomes available indicating that an agent has adverse effects on non-target animals, the use of the agent would stop or be modified to eliminate risks. Both leuprolide and GonaCon™ are proteins that are broken down during digestion, posing no risk of passing into the food chain (APHIS 2005, Becker and Katz 1993).

Potential Agents

While other agents may become available in the future, currently leuprolide and GonaCon™ could potentially be used to control elk populations. A description of these two agents and their potential for use in the park follows:

Leuprolide is an agent involving a gonadotropin-releasing hormone (GnRH) agonist (counteracts GnRH). Produced by the hypothalamus, a major portion of the brain, GnRH is part of a pathway that signals the body to produce sex hormones; without it, very little estrogen is produced. Leuprolide acts to suppress the secretion of this reproductive hormone. This drug is approved for

therapeutic use in humans, and the four-month formulation has been shown to suppress ovulation and estrus in cow elk for one breeding season (Baker et al. 2002). Extra-label use of leuprolide, in accordance with the Animal Medicinal Drug Use Clarification Act of 1994, would require a prescription by a veterinarian. The veterinarian would also be responsible for establishing the withdrawal period for the drug or determining that there is no withdrawal time. The treated animals would require marking to prevent human consumption of the meat until the established period has past.

Treatment with leuprolide would occur between mid-July and mid-September. As described in "Requirements for Treatment Agents" section, leuprolide would be unlikely to cause loss of fetuses when pregnant elk are treated (D. Baker 2004). However if loss of fetuses is found to occur in elk, treatment times for use in the field would be adjusted to prevent treatment of pregnant elk.

GonaCon™ is a GnRH immunocontraceptive vaccine. Immunocontraception involves the production of antibodies that attack specific proteins, resulting in infertility. The aim of a GnRH vaccine is to bind to or "tie up" the GnRH produced within an animal's body so that it does not trigger reproduction. The vaccine induces the body to make antibodies against its own GnRH. As a result, following injection, the hormone's function is neutralized, resulting in infertility in females (NWRC 2004).

GonaCon™ has been shown to be effective in various wildlife species with one dose when administered with the AdjuVac adjuvant, a compound that increases the levels of antibodies (NWRC 2004). The vaccine has not yet received adequate evaluation in elk. However, it could be immediately tested on cow elk in the park on a strictly regulated, investigational basis with an investigational, new animal drug exemption and prescribing-veterinarian approval. The study would be terminated if monitoring found that the agent did not meet all criteria. Because GonaCon™ is not a regulatory-approved agent in any species, all treated elk would require a long-term mark to prevent human consumption of meat from treated elk.

The safety and effectiveness of GonaCon™ on calves is unknown.

Treatment with this agent would occur from November through mid-September to allow the agent to be effective in the upcoming breeding season. If loss of fetuses is found to occur in elk when tested in a controlled setting, treatment times for use in the field would be adjusted to prevent treatment of pregnant elk as described in "Requirements for Treatment Agents" section.

Lethal Reduction

Because of the remoteness of the park, the wide dispersion of elk in the summer months, and the short period within which to treat the elk, treatment of 400 elk with a fertility control agent each year may be difficult. If this number of elk could not be treated within the period, then additional lethal removal actions by NPS personnel and their authorized agents may be needed to further supplement the fertility control actions to meet population level objectives. See Appendix H for further discussion of culling and authorized agents. The number of elk that would need to be lethally removed each year would be 80 to 150. Lethal reduction inside the park would be carried out under controlled conditions as described above for Alternative 2. Because of the lower number of animals to be removed each year, a temporary capture facility could be used as an adaptive tool if other methods are shown to be less effective.

Unless a multi-year agent became available, lethal reduction would be needed more during the later years of the plan as the logistical constraints of applying fertility control increases due to increased elk wariness. As logistical capabilities for using fertility control improve or longer-

acting drugs are developed, fertility control could become the sole means of controlling the elk population size.

Elk Distribution

Elk would still be expected to continue to use the primary winter and summer ranges but at moderately reduced numbers and densities. The dispersal effects on elk from the use of unsuppressed (noisy) weapons during any lethal reduction actions would be the same as those described in Alternative 3. Fertility control activities using remote darting would have minimal dispersal effects.

The use of herding, aversive conditioning, and unsuppressed weapons to redistribute elk would be as described above for Alternative 2, however they would occur more frequently. Because of the low use of lethal reduction and minimal dispersion that would result from fertility control actions, the park would frequently conduct aversive conditioning and herding to reduce browsing pressure on aspen and willow at a similar level as described in Alternative 3. The distribution response of elk as a result of fertility control and lethal removal activities, herding, aversive conditioning, and fences (discussed below) would be monitored to determine the efficacy of the methods.

Vegetation Management

Vegetation management methods and timing would be similar to those described above in Alternative 3. Under this alternative it is expected that 160 acres of aspen habitat on the primary elk range would be fenced. It is expected that 260 acres of suitable willow habitat on the primary winter range would be fenced. Fences would not be used on the primary summer range as in Alternative 3 but would rely on elk redistribution techniques to protect riparian willow habitat on this portion of the primary elk range. Monitoring of vegetation communities would provide the information necessary to determine how many acres of willow or aspen on the primary elk range need to be protected. Similarly, monitoring data would provide the information necessary to determine when fences can be removed once communities are restored.

Once an area was adequately protected from elk herbivory, willow cutting plantings, mechanical thinning or removal, prescribed burning, or recolonization by beaver could be used to facilitate regeneration of vegetation on the elk range as described in Alternative 2. These restorative methods could probably be used earlier in the planning process in fenced areas due to the higher level of protection against elk herbivory.

Distribution of Carcasses

The distribution of carcasses would be as described in the section "Elements Common to All Action Alternatives." To the extent possible elk carcasses and meat resulting from these actions would be donated through an organized program to eligible recipients including members of tribes based on informed consent and pursuant to applicable public health guidelines. Through time, the number of carcasses needing to be disposed under this alternative could decline as elk population management would rely more on fertility control with less reliance on lethal reductions.

Chronic Wasting Disease Prevalence Testing

All adult elk subject to lethal removal would either be removed entirely from the field or the heads would be taken and tested for chronic wasting disease.

With the current fertility control technology, under this alternative, the number of elk tested would be similar to Alternative 3 if a field test does not become available that allows testing of live elk. The number tested would decline if the technology of the fertility control agents improved such that management of the population could be predominantly a result of fertility control activities rather than lethal reduction.

If a field test that provides immediate results becomes available, allowing live testing for chronic wasting disease in elk, elk that are captured during fertility control activities would be immediately tested, and those testing positive for the disease would be preferentially lethally controlled to reach the target elk population number. Those elk in which chronic wasting disease has not been detected could be treated and released. If a field test becomes available, the number of elk tested under this alternative would be greater than under any other action alternative.

Minimum Requirement / Minimum Tool Analysis

A programmatic analysis of elements of the alternative has been included in the minimum requirement analysis that is provided in Appendix G. Under this alternative, the elements listed below would require analysis through a minimum tool analysis which would be conducted prior to implementation of site-specific actions. For a detailed discussion of the minimum requirement process, refer to the "Wilderness Minimum Requirement Analysis" section in "Elements Common to All Alternatives."

The following actions of Alternative 4 have been evaluated in a minimum requirement analysis (see Appendix G) and would also be subject to a minimum tool analysis prior to their use in wilderness areas.

The use of firearms to lethally remove elk or dart guns to anesthetize elk or to remotely treat elk with fertility control agents.

The use of helicopters for monitoring elk and transporting fence materials. Although unlikely, helicopters could also be used adaptively if necessary for herding elk and for removing carcasses from remote locations due to disease management concerns.

The use of horses to herd elk or remove carcasses.

The use of trained herding dogs to herd elk.

The use of all-terrain vehicles or trucks to remove carcasses.

The use of a temporary capture facility to administer fertility control agents, identification of appropriate locations for the facility, and use of equipment to transport and erect the facility.

The use of aversion techniques to disperse elk.

The use of fences to protect aspen and suitable willow habitat and the equipment used to transport and erect the fences.

The use of prescribed burning, identification of appropriate locations for burns, and use of equipment necessary to conduct those burns.

The use of mechanical thinning activities, identification of appropriate locations, and use of equipment necessary to conduct the actions.

ALTERNATIVE 5

This alternative would involve lethal reduction (culling) of elk in combination with the release and intensive management of a limited number of gray wolves within Rocky Mountain National Park in a phased approach to achieve an elk population that would fluctuate within the natural range of variation between 1,200 to 2,100 elk. National Park Service staff and their authorized agents would lethally remove 50 to 500 elk annually in the first four years to bring the population to 1,600 to 2,100 animals, which is on the high end of the natural range of variation. Up to 100 elk would be lethally removed annually over the next 16 years to meet the target population range. See Appendix H for further discussion of culling and authorized agents. At the same time, a small number of wolves would be released and then allowed to gradually increase to a maximum of 14 over the life of the plan. The number of wolves would be increased after determining through monitoring that the National Park Service could effectively manage the wolf population and that wolves would contribute to accomplishing the plan's management objectives of reducing elk densities and thus restoring vegetation conditions.

All discussion of wolves in this section is specific to those that are released and intensively managed and not related to naturally recolonizing wolves.

Because of the limited number of wolves under this alternative, lethal reduction would be the primary elk population reduction tool and wolves would be the primary redistribution tool. To the extent possible elk carcasses and/or meat resulting from these actions would be donated through a an organized program to eligible recipients based on informed consent and pursuant to applicable public health guidelines.

Elk Population Reduction

Lethal Reduction

During the initial phases of the plan, the small number of wolves would not be expected to contribute to the reduction of the elk population size. Therefore, lethal reduction (culling) of elk by NPS personnel and their authorized agents would be needed to reduce the elk population to within the natural range of variation and to facilitate meeting vegetation restoration objectives. Within the first four years of the plan, the elk population would be reduced by lethal reduction action to the high end of the natural range, 1,600 to 2,100 total elk (600 to 800 park subpopulation and 1,000 to 1,300 town subpopulation). This would be accomplished by the annual lethal removal of 50 to 500 elk. To maintain the elk population at the high end of the range, up to 100 elk could be lethally removed annually over the remaining 16 years of the plan. As the number of wolves in the park increases throughout the plan, the need for supplemental lethal reduction may decline. During later years of the plan, the elk population would be maintained between 1,200 and 2,100 (200 to 800 park subpopulation; 1,000 to 1,300 town subpopulation), depending on the effectiveness of elk redistribution by wolves and resulting vegetation conditions. The methods for lethal reduction would be the same as those defined above under Alternative 2.

Elk Distribution

The presence of wolves would be expected to disperse elk and inhibit them from over-concentrating on the elk range to varying degrees, based on the number of wolves present. Large concentrations of elk would be expected to disperse; however, due to the uncertainty of how elk

would respond, a full analysis would be conducted throughout the life of the plan to track changes in elk distribution at varying wolf population levels. The distribution response of elk as a result of wolf release would be monitored as described in the "Monitoring and Data Collection" section of this chapter. No additional aversive conditioning or herding would be anticipated under this alternative.

Wolves

A limited number of gray wolves would be released in the park in a phased approach. Their breeding capacity and movements would be intensively managed over the life of the plan. This strategy of using wolves as a tool to manage wildlife has never been conducted and not all experts agree that an intensively managed wolf population is feasible biologically or logistically; therefore, this alternative is considered to be experimental. It is uncertain whether wolves would establish within the park, whether they would remain within the park boundaries, whether they would redistribute elk on the primary winter range enough to allow vegetation to recover, and how they would react to frequent recapture and release, if needed. Logistical problems in implementing the program could include obtaining permits for wolves as long as they are federally protected, finding a source of wolves, managing to keep wolves within park boundaries, and retrieving wolves that may cross park boundaries. This alternative, however, is being considered because wolves have been shown to be effective in controlling elk populations and have indirectly improved vegetation such as willow and aspen in other areas (Fortin et al. 2005, Coughenour 2002), so they are considered a potential tool for elk management within Rocky Mountain National Park.

It is expected that a small number of wolves would be able to meet the plan objectives by redistributing elk. Elk may use more open areas, move more frequently, and congregate less due to the threat of predation (Fortin et al. 2005), or they may retreat in smaller groups to areas of wooded vegetation to avoid detection by wolves (Creel and Winnie 2005). At higher wolf numbers, it is expected that wolves may also reduce elk population size to some degree through predation. With very small wolf numbers early in the planning period, lethal reduction actions by NPS personnel and their authorized agents would be needed to reduce elk numbers and densities to meet management objectives.

As long as the gray wolf is a federally protected species, the National Park Service would need approval and applicable permits from the U.S. Fish and Wildlife Service to acquire, release, and manage wolves in the park. The proposed use of wolves may not be compatible with the provisions of the Endangered Species Act, as it does not promote recovery of the listed species and it is uncertain whether approval would be granted. Permits would also be needed from individual states to allow transport between states and from the agency providing the source wolves. To implement this alternative, the National Park Service would be required by the U.S. Fish and Wildlife Service to develop a detailed plan describing the process to transport, release, and manage wolves in the park. This more detailed plan would be subject to further NEPA compliance and further consultation with the U.S. Fish and Wildlife Service.

Wolves would be released and managed in the park according to a rigid set of guidelines using two adaptive phases. In each phase, the number of wolves would be strictly controlled using fertility control methods or by removing individuals from the population. Throughout plan implementation, it may be necessary to bring in individual wolves to replace established wolves that may be lost due to mortality. The number of wolves that could be brought into the park would depend on constraints such as funding, appropriate approvals, and source availability. Under this alternative, all wolves would be fitted with global positioning system tracking collars, and their movements and activities would be strictly monitored.

The National Park Service has established required management criteria to meet during implementation of this alternative:

1. Wolves would be restricted to within park boundaries and be adequately managed to mitigate safety and property concerns. NPS staff or contractors would be hired and dedicated to managing and monitoring the wolves on a daily basis. Wolf movements would be strictly controlled to prevent any from crossing the park boundary unless there is cooperation with Colorado Division of Wildlife for management of wolves outside the park. Wolves that approached the boundary would be immediately moved back into the park by capture and transport back to a soft release pen. Although success of aversive conditioning methods is uncertain, such techniques would be attempted on wolves approaching the boundary. If these actions were not successful in keeping a wolf within the park, it would be relocated to an unoccupied territory outside the park (area with no wolves present that would be in need of wolves) or to a wolf sanctuary, or it would be lethally removed. If a wolf attacked domestic livestock (cattle, sheep, or horses) or other domestic animals such as pets, it would be lethally removed. The number of occurrences and the type of actions taken would be determined on a case-by-case basis for each individual wolf. Although there are no state or federal compensation programs for wolf-caused losses of domestic livestock, programs established by private groups, such as Defenders of Wildlife, may be applicable.
2. Wolves must find and kill elk as a primary food source. If not using elk as a primary food source, wolves would be removed from the park by capturing and relocating to an unoccupied territory outside the park or to a wolf sanctuary, or they would be lethally removed. Wolves may prey on other wildlife species such as deer or moose, and they may have a more diverse diet in the summer; however, their primary prey species should be elk.
3. Wolves must effectively redistribute elk. Wolves would be monitored to determine their effectiveness in meeting dispersal management objectives.

As stated earlier, use of wolves as a management tool to control elk populations involves numerous uncertainties:

Whether the park could gain appropriate regulatory approvals to obtain wolves for release in the park;

Whether wolves would establish in the park;

Whether park managers could effectively control wolf behavior and movements and keep wolves in the park; and

Whether a limited number wolves could redistribute elk to allow vegetation recovery.

Based on monitoring, the park would stop the use of wolves as an elk management tool at any time during the plan if any of the above criteria were not met or if wolves were not contributing to meeting the management plan objectives. The wolves would then be captured and relocated or lethally removed as described above, and the management plan would rely on lethal reduction of elk by NPS personnel and their authorized agents, as defined in Alternative 2.

During Phase 1, the National Park Service would evaluate how effectively the wolves could be managed, whether management objectives were being met, and the level of impact on other resources. The goal of Phase 1 would be to have at least one pair of wolves establish within a territory centered on the east side of the park, where the greatest extent of elk degradation on vegetation has occurred. To increase the potential to meet this goal and to evaluate the ability of the park to manage wolves, the park would release two pairs of wolves (two females and two males) using a soft release method on the east side of the park. Releasing two pairs would

increase the potential of at least one pack establishing residence. A soft release involves allowing the wolves to acclimate in the general area of release in a confinement facility, providing them carcasses for food for six to eight weeks, and then releasing them to range freely in the park.

Male wolves would be given vasectomies to prevent reproduction. Females would retain their reproductive abilities. The reason males would be treated is because the surgery is less invasive in males than females and therefore less risk of complications and also because the vasectomy would be reversible. Vasectomies could be achieved through surgical means. The wolves would be expected to exhibit normal social behavior and establish territories, as suggested by research conducted on surgically sterilized wolves (Spence et al. 1999, Haight and Mech 1997, Mech et al. 1996a, and Mech et al. 1996b). This research indicates that wolves with vasectomies stayed in their territories and maintained pair bonds and performed breeding behavior such as digging dens.

If a wolf would die during Phase 1, its partner would be brought back to the soft release pen, a new mate would be introduced to the pen, and the pair would be released once a pair bond was established. After two to three years of monitoring and evaluating data, the National Park Service would determine whether to advance to Phase 2.

In Phase 2, the wolf population would be allowed to increase within the park, under tight control, to the optimum number of wolves to meet the management plan objectives while continuing to maintain management control. Wolves would need to demonstrate effective distribution of elk. As in Phase 1, the ability of the managers to control the wolves and the level of effects on resources would continue to be evaluated as the number of wolves increased.

The male wolves from Phase 1 would undergo vasectomy reversal to allow reproduction. Vasectomy reversal has been conducted successfully in canids and is considered a relatively simple procedure (Wittenauer 2005). The reversal would be performed by a veterinarian using aseptic methods to reduce surgery related risks. In this phase, wolf movements, activities such as denning, and population growth would be monitored. Managers would control the size of the wolf pack by such means as embryo reduction and/or removal of pups. Removed pups would be taken to captive wolf facilities or lethally removed, if necessary. Ecosystem simulation modeling (Coughenour 2002) has predicted that wolves released into Rocky Mountain National Park would stabilize in the park at a population of 14. Therefore, under Phase 2, the wolf numbers in the park would not be allowed to exceed 14 animals.

The intensive management of wolves under this alternative would result in stress to those individuals. The National Park Service recognizes this result and would, within the constraints of an action, reduce to the greatest extent possible any pain or distress that the actions may cause.

Vegetation Management

Under this alternative, it is expected that 160 acres of aspen habitat on the elk range would be fenced. Due to the presence of wolves and the redistribution of elk that would be expected under this alternative, fences would be installed adaptively based on vegetation response, as indicated through the monitoring program. Because wolves are expected to effectively disperse elk, the amount of fence that would be installed is expected to be less than under other alternatives. The installation of fences could begin in the first year of the plan to allow monitoring vegetation response to management actions (e.g., control plots) as well as to provide protection from elk browsing. The amount of fences that would be installed in the first 10 year of the plan would be limited to the extent possible to allow ample time to determine vegetation response to elk management actions and for further research to determine whether the presence of aspen in the elk range is part of the natural condition.

Monitoring of vegetation communities would provide the information necessary to determine how many acres of willow or aspen on the primary elk range need to be protected. Similarly, monitoring data would provide the information necessary to determine when fences can be removed once communities are restored.

With reduction in the elk population and increased dispersal and movement of elk by wolves and lethal reduction activities, it is expected that vegetation would recover naturally. Fences therefore would not be used to protect montane riparian willow on the primary winter range. Once an area was adequately protected from elk herbivory, willow cutting plantings, mechanical thinning or removal, prescribed burning, or recolonization by beaver could be used to facilitate regeneration of vegetation on the elk range as described in Alternative 2. The ability to use restorative techniques, particularly in unfenced areas, would likely occur later in the planning process.

Distribution of Carcasses

The distribution of carcasses would be as described in the section "Elements Common to All Action Alternatives." To the extent possible elk carcasses and/or meat resulting from these actions would be donated through an organized program to eligible recipients based on informed consent and pursuant to applicable public health guidelines. The number of carcasses left in the environment would reflect a natural state to the greatest extent possible; however, the logistical challenges of removing large numbers of carcasses during the first four years of the plan may require leaving some carcasses in the field after carefully considering impacts on natural resources, wilderness, and visitors. The number of carcasses needing to be disposed under this alternative would decline over time as elk population management would rely more on wolves with less reliance on lethal reductions.

Chronic Wasting Disease Prevalence Testing

During the initial phases of the plan when wolf numbers are low, chronic wasting disease prevalence testing would be the same as described above under Alternative 2. Eventually, the elk population size reduction may be predominantly by wolves rather than lethal reduction. NPS staff would be aware of the location of wolf kill sites through intense monitoring of wolves and their activities. Awareness of wolf predation locations would facilitate the collection of samples of wolf-killed elk for chronic wasting disease testing. The hypothesis that wolves may selectively prey on elk infected by chronic wasting disease could be evaluated by testing as many wolf-killed elk carcasses for the disease as possible.

Minimum Requirement / Minimum Tool Analysis

This alternative would require the development of a detailed plan to obtain, transport, release, and manage wolves in the park, with further NEPA compliance required at that time. A programmatic analysis of elements of the alternative has been included in the minimum requirement analysis that is provided in Appendix G. This alternative would also require evaluating implementation of the specific actions in wilderness areas of the primary elk range with a minimum tool analysis which would be conducted prior to implementation of actions. For a detailed discussion of the minimum requirement process, refer to the "Wilderness Minimum Requirement Analysis" section in "Elements Common to All Alternatives."

The following actions of Alternative 5 have been evaluated in a minimum requirement analysis (see Appendix G) and would also be subject to a minimum tool analysis prior to their use in wilderness areas.

The use of firearms to lethally remove elk or dart guns to anesthetize elk.

The use of helicopters for monitoring elk and wolves and transporting fence materials. Helicopters could also be used adaptively if necessary for removing carcasses from remote locations due to disease management concerns.

The use of a temporary capture facility to conduct lethal reduction actions, identification of appropriate locations for the facility, and use of equipment to transport and erect the facility.

The use of holding pens for wolves, identification of appropriate locations for holding pens, and use of equipment to erect the pens.

The use of horses to herd elk or remove carcasses.

The use of trained herding dogs to herd elk.

The use of all-terrain vehicles or trucks to remove carcasses.

The use of fences to protect aspen and use of equipment to transport and erect the fences.

The use of prescribed burning, identification of appropriate locations for burns, and use of equipment necessary to conduct those burns.

The use of mechanical thinning activities, identification of appropriate locations, and use of equipment necessary to conduct the actions.

Education

In addition to the education program described in the "Elements Common to All Action Alternatives" section of this chapter, the National Park Service would develop additional educational elements for the public regarding wolves and their role in the ecosystem and in managing elk populations. In addition, the program would include educating the public regarding the safety risks associated with wolves. This material would include information such as how to stay safe around wolves; how to protect pets, livestock, and property from wolves; and viewing etiquette.

ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Several actions suggested by the public were not incorporated into this plan/EIS. In Section 4.5(E)(6) of the NPS NEPA Guidelines (NPS 2001c), reasons to eliminate an alternative as infeasible include technical infeasibility, inability to meet project objectives or resolve need, conflicts with plans, policies or laws "such that a major change" would be needed to implement, and duplication with other, less environmentally damaging, less expensive or more feasible options, or has too great an environmental impact.

This section describes those alternatives or management tools that were eliminated from further consideration and the basis for excluding them from analysis in this plan/EIS.

Public Hunting within the Park: During public review of the draft plan/EIS, many comments advocated the use of hunting in the park to manage the elk population. During the planning process, an alternative was considered that would allow the public to be involved in management actions inside the park to directly reduce the elk population. This type of hunt would have involved opening areas of the park on the winter range to hunting using a lottery system reflective of a traditional hunt.

It is important for the reader to understand the differences between public hunting and culling activities. Although public hunting and culling are both used as conservation tools in ungulate management, there are differences between hunting and culling that must be clarified. Hunting is a recreational activity administered by state wildlife agencies through licenses and it involves fair chase and the taking of meat by the individual hunter. Culling, on the other hand, is a tool used to reduce populations that have exceeded their carrying capacity. It is a very controlled and structured activity, not a recreational activity like hunting, to minimize and/or prevent impacts on other members of the public and other resources. Because of the controlled nature of the activity, the proven skill of those authorized to take action, and the ability to be flexible in timing, location, and choice of management tools, culling actions are more efficient and potentially safer than hunting. Another important distinction is that carcasses and/or meat resulting from culling actions can be donated through an organized program to eligible recipients. More details and explanation of the differences between hunting and culling activities are provided in the text that follows as well as in Appendix H.

The National Park Service recognizes that public hunting is an important recreational activity and wildlife management tool in Colorado. Currently, hunting wildlife is permitted on approximately 98% of the federal lands in Colorado, including lands owned and managed by the U.S. Forest Service, Bureau of Land Management, and numerous national wildlife refuges throughout the state.

Traditionally, and as mandated through law, hunting has not been allowed in national parks. Congress has authorized hunting in at least 69 of the 390 National Park Service units and ungulate hunting occurs in at least 50 of the units that allow hunting. The units in which hunting is authorized are designated primarily as national rivers, lakeshores, seashores, recreation areas, preserves, and monuments. Outside of national parks in Alaska, Grand Teton National Park is the only national park in which hunting is allowed. Congress passed specific legislation in 1950 authorizing hunting (by licensed hunters deputized as park rangers) in portions of Grand Teton National Park, in part because elk were being fed on adjacent U.S. Fish and Wildlife Service lands.

National parks are recognized as nationally significant areas that preserve outstanding resources for the enjoyment of millions of visitors. In managing the National Park System, the National

Park Service must consider the impact of uses on park resources, including cultural and natural resources, when determining appropriate uses in fulfilling its obligation to provide for the enjoyment of the parks by the public. An appropriate use has been defined as a use that is suitable, proper, or fitting for a particular park or portion of a park. Providing enjoyment to the public is a critical component of the Organic Act. This enjoyment is for all citizens, whether they visit the parks or appreciate them from afar. The types of enjoyment that National Park Service units provide are "uniquely suited and appropriate to the superlative natural and cultural resources found in the parks." NPS policy also directs "high quality opportunities for visitors to enjoy the parks, and maintain within the parks an atmosphere that is open, inviting, and accessible to every segment of American society." Each of these mandates or policies may be impacted by hunting. Therefore, Congress has allowed hunting only in those units in which it is an appropriate use.

Using public hunting within Rocky Mountain National Park as a management tool for controlling the elk population would significantly displace the existing recreational use of the park by visitors. There are 90 years of expectations that recreational activities can take place in Rocky Mountain National Park without interference from hunting. Over three million visitors come to Rocky Mountain National Park each year to enjoy a variety of outstanding recreational activities, some of which are not available in areas outside the park. Given its proximity to Denver and other front range communities, it is in many ways an "urban" park and receives visitation year round. Hiking, horseback riding, snowshoeing and skiing in the backcountry are very popular activities along with sightseeing and wildlife viewing along the park's roadways.

The National Park Service recognizes and supports the Colorado Division of Wildlife's management of wildlife in areas outside and adjacent to the park through hunting. However, considering the current situation with the elk population using both the park and Estes Park as a refuge, hunting on national forest lands adjacent to the park does not resolve the needs established in the "Purpose and Need" chapter of this plan. As stated earlier in this plan/EIS, the agencies participating in this planning effort have recognized this concern and accept that because elk use areas beyond the park boundaries, management of the elk population requires continuing management by all agencies, both inside and outside the park. The effectiveness of the National Park Service actions inside the park to reduce the elk population and resolve the need for the plan would be greatly augmented if other agencies would take additional action outside the park. The National Park Service would continue to work collaboratively with the agencies outside the park in consideration of additional future actions that could be taken to manage the elk that use Estes Park as a refuge from hunting. The National Park Service would work throughout implementation of this plan to monitor changes in the elk population size in collaboration with the Colorado Division of Wildlife so that management actions can be adapted as needed inside the park to maintain a population size within the natural range of variation.

Using public hunting within the park as a tool to manage the elk population poses several concerns, based primarily on conflicts with traditional visitor uses of the park and effectiveness in meeting management objectives. All of the concerns discussed below were considered by the National Park Service in the evaluation of public hunting as an alternative for elk and vegetation management within the park.

A traditional hunt in the park would require the temporary closure of large areas on the primary elk range to allow enough area for hunters to safely hunt and enough time to find, kill, and remove the animals. To effectively meet management objectives, heavily used and popular areas of the elk primary winter range would need to be closed in the fall. Using trained NPS staff and authorized agents to cull elk (see Appendix H for a discussion of culling and authorized agents) would provide greater flexibility in the timing of reductions and the methods used to remove elk and the carcasses. Using a limited number of expertly trained NPS staff and authorized agents

with highly specialized equipment and flexibility in methods to remove elk, trained personnel could selectively reduce the population with a minimum of disturbance to the other animals and to visitors from noise and actions associated with removal of carcasses. A traditional hunt without such flexibility and with less ability to mitigate impacts on visitors would conflict with the traditional uses of the park, significantly impact visitors' ability to enjoy outstanding park resources, and potentially increase the risk to public safety which is discussed in more detail below.

An alternative that involved public hunting to manage elk inside the park would be inconsistent with existing regulatory authority regarding public hunts in national parks and with longstanding basic policy objectives for NPS units, and because the likelihood that the park service would change its longstanding service-wide policies and regulation regarding hunting in parks is remote and speculative. (See Natural Resources Defense Council, Inc. v. Morton, 458 F.2d 827 [D.C.C. 1972]; National Rifle Association v. Potter, 628 F.Supp. 903 [1986]; NPS Director's Order 12 Handbook page 50; Headwaters, Inc. v. Bureau of Land Management, 914 F.2d 1174, 1181 [9th Cir. 1990]; Seattle Audubon Society v. Moseley, 80 F.3d 1401, 1404 [9th Cir. 1996]; Kootenai Tribe of Idaho v. Veneman, 313 F.3d 1094 [9th Cir. 2002]).

Throughout the years, the National Park Service has taken differing approaches to wildlife management, but has for the most part, from the beginning, maintained a strict policy of not allowing hunting in national parks. In 1929, Congress prohibited hunting within the limits of Rocky Mountain National Park. In the 1970s, Congress passed the General Authorities Act and the Redwood Amendment, which clarified and reiterated that the single purpose of the Organic Act is conservation. While the Organic Act gave the Secretary of the Interior the authority to destroy plants or animals to prevent detriment to park resources, it did not give the Secretary authority to permit the destruction of animals for recreational purposes. In 1984, after careful consideration of Congressional intent with respect to hunting in national parks, the National Park Service promulgated a rule (36 CFR 2.2) that allows public hunting in national park areas only where "specifically mandated by federal statutory law." The National Park Service has reaffirmed this approach in its management policies (NPS 2006).

Congress has not authorized hunting in any legislation for Rocky Mountain National Park. Therefore, to legally allow hunting at the park, Congress would need to specifically authorize hunting in Rocky Mountain National Park and the park service would need to promulgate a new regulation to implement the congressional action. The National Park Service has a legislative mandate to protect the natural and cultural resources within national parks to allow for their enjoyment by future generations. The National Park Service does not have a mandate to allow public hunting in parks. At this time, the National Park Service intends to exhaust all other possible alternatives before attempting to change its governing laws, regulations, or policies, due to concerns that such actions may have negative impacts on the resources of other parks in the national park system.

In addition to legal and policy-related concerns, hunting in the park was also preliminarily evaluated based on efficiency. Public hunts have been shown to be less efficient in meeting ungulate reduction project goals when compared to lethal reduction by trained agency staff. Doerr et al. (2001) noted that the highest kill rate (0.55 deer/hr) was achieved when lethal reduction actions occurred over bait. This was compared to hunting, which resulted in a rate of 0.03 deer/hr or 31 hunter-hours per deer killed. In addition to harvest rates, lethal reduction actions by agency staff also provided a higher selectivity than hunting. As the reduction in females was the primary goal, hunting took 59% females, whereas the take resulting from lethal reduction actions was 63% females (Doerr et al. 2001).

In addition to efficiency, safety is also an issue to consider when using lethal reduction methods. Lethal reduction actions by NPS staff and authorized agents offers safety features that a traditional hunt does not. Lethal reduction actions may need to take place during periods of high visitation or in high visitor use areas of the elk range. Hunting near developed areas or in areas that are frequently used by visitors increases the potential risk to public safety. Lethal reduction by NPS staff and authorized agents however provides an ability to more effectively mitigate the risks to the public and to adapt management actions based on monitoring the effectiveness of methods and the impacts. Mitigations to further reduce the risk to visitors that could be employed by NPS staff and authorized agents include but are not limited to shooting from an elevated stand in established shooting lanes with a backstop to control the distance traveled by the ammunition and using spotters to ensure that no visitors are in or near the area when actions are occurring as opposed to closing large areas of the park.

An additional concern with a traditional hunt is the increased potential to disperse elk to areas outside the park. As recognized as a concern in the "Purpose and Need for the Plan" section, elk already seek refuge in the Estes Park area from hunting that occurs on adjacent lands. Hunting in the park may only serve to exacerbate this problem by pushing even more elk into Estes Park, increasing potential risk to the public and property. Lethal reduction actions by NPS staff and authorized agents provide greater flexibility in mitigating this risk by the type of weapon used and selection of areas to implement the action.

A potential problem associated with relying on public hunting as a management tool in the park is whether an adequate number of hunters would participate annually. A lack of or decline in participation over the life of the plan could seriously impact the effectiveness of public hunting as a management tool, especially over the long term. Numerous people during public scoping and review of the draft plan/EIS expressed interest in helping the park reduce the elk population, but there is no assurance that this public interest in participating in population control would continue over the 20-year life of the plan. A number of studies that have analyzed managed public hunts have shown that retaining adequate hunter numbers is difficult, especially as ungulate densities drop and management enters the maintenance phase. Hansen and Beringer noted that "managed firearm hunts…lasting more than two consecutive days are not cost effective because participation and harvest decline sharply after day 2" (1997). In fact, they experienced difficulty recruiting adequate hunters for areas that already had experienced hunts. Kilpatrick and Walter experienced a 66% decline in hunter applicants in Connecticut from the first to the second years of a controlled hunt (1999), a 26% decrease in hunter participation after one year. Without consistent annual hunter effort, long-term management through public hunting would likely be unsuccessful and would need to be supplemented with or converted to lethal control by NPS staff and their authorized agents.

Although costs were not a primary consideration in the range of alternatives to be evaluated, it should be noted that a public hunt could not be done without costs to the National Park Service. A public hunting alternative would include cost for visitor management and for increased personnel to establish and manage closures while hunting was occurring; public relations including working with and/or managing the media would need to be funded to inform visitors of hunting activities in the park, associated closures, and additional safety precautions when using the park during the hunting period; additional public relations and enforcement staff and funding would be needed to address any public protests that might occur because of opposition to hunting in national parks; dedicated staff time would be necessary to direct, manage, and oversee the hunts; and additional staff time would be necessary for coordination of hunting activities with other park actions and activities. As with all of the action alternatives considered in this plan/EIS, an alternative that includes public hunting would also incur the costs of distribution activities that would need to occur when reduction actions are not being taken to ensure recovery of the

vegetation on the primary elk range. Fences would need to be installed and maintained to protect aspen and willow. A monitoring program would be implemented to assess results of management actions to determine whether management objectives were being met or whether management actions would need to be altered.

In conclusion, the National Park Service considered and rejected a special public hunt as a reasonable alternative for this plan for the following reasons: 1) implementing a public hunt in Rocky Mountain National Park would significantly conflict with the long-standing traditional uses of the park and have significant impact on the visitor use and experience; 2) allowing a public hunt would require changes to basic NPS policy and, a change in federal law; 3) case law supports dismissing an alternative that would require a major change in long-standing basic policy; 4) other alternatives, such as lethal reduction by NPS staff and authorized agents, could be implemented without changing current laws and policies; 5) other alternatives, such as using trained NPS staff and their authorized agents, raise fewer safety concerns, would impact other visitors to a lesser degree, and would have substantially the same environmental effects; 6) other alternatives, such as using lethal reduction by NPS staff and their authorized agents, would have a higher degree of efficiency, and 7) other alternatives, such as using lethal reduction by NPS staff and their authorized agents would better meet the purpose, needs, and objectives of the plan, in accordance with Council on Environmental Quality(CEQ) regulations, than would a special public hunt.

Maximum Habitat Manipulation: This alternative focused on fencing all aspen and riparian willow habitat on both the primary winter and summer ranges in the park. The goal was to prevent access by elk to large portions of the preferred elk foraging habitat, encouraging elk to seek suitable forage in other areas of the park, Estes Park, or surrounding National Forest Service lands. Elk displaced from habitat they currently use in the park could intensify problems in areas that would remain unfenced. Significant questions were raised about whether this alternative would successfully meet the objectives of the plan, as well as concerns that the problems and impacts associated with elk would be shifted to other areas (e.g., upland habitats in the park and other locations outside the park, including Carter Lake and Loveland). Specifically, questions about the ability to fence the amount of area necessary to achieve vegetation objectives in the park, the impacts on visitor experience, and a lack of control over where elk would move limited this alternative's capability to achieve the plan's objectives. This alternative was not considered for further evaluation because it would likely shift the problem rather than solve it and would not adequately achieve the plan's objectives.

Translocation: This alternative would have involved capturing elk within the park and transporting them to areas outside the park with suitable habitat. This option to reduce the elk population would conflict with current NPS and state policies that prohibit exportation of elk from areas in which animals are known to be infected with chronic wasting disease to areas in which animals are not known to be infected. Although translocation has been used in the past by the park and other NPS units to address elk overpopulation, this incidence of chronic wasting disease in the elk population makes trapping and transporting a potential hazard to wildlife and to public health and safety. Therefore, this alternative was dismissed from further consideration.

Shipment to Euthanizing Facility: One management tool considered early in the planning phase was to capture elk by corralling and then shipping them to a facility to be euthanized. Based on further evaluation and discussions with the NPS veterinarian as well as public input from the U.S. Humane Society, it was determined that shipment to slaughter would cause greater stress on the animals as they are corralled, handled, and guided into trucks for transport to the facility, resulting in an increased potential for self-induced injury to the animals. It had been determined that lethal removal in the field through the use of trained agency staff; anesthetizing and euthanizing; or capturing, anesthetizing, and euthanizing would achieve the population

objectives of the plan while lessening to the extent possible the pain and distress caused to the individual elk. Shipping to a facility outside the core area of chronic wasting disease infection would conflict with NPS and state policies for transport of elk from areas where chronic wasting disease is known to exist. Therefore, capturing and shipping animals to a euthanizing facility was not further analyzed in the plan/EIS.

Maximum Fertility Control throughout the Planning Period without Lethal Reduction: This alternative would have relied on fertility control as the only means of reducing and maintaining the elk population throughout the 20-year planning period. Early in the planning process, the agencies evaluated an alternative using available fertility control technologies to manage the elk population without the need to lethally remove elk. Only short-term fertility control agents would be available for immediate implementation. Based on population modeling projections, approximately 900 female elk would need to be treated annually to reach a population at the high end of the natural range of variability (1,600 to 2,100 animals) by the end of the 20-year plan. This alternative was dismissed from further consideration as unreasonable to implement for a number of reasons. It would be logistically and economically infeasible for NPS staff and their authorized agents to capture and treat annually such a high number of free-ranging female elk. Treating 400 deer per year even with the most effective, remotely delivered contraceptive is beyond the logistical capabilities of most commercial ranching facilities or zoos (NPS 2004c). The capture, treatment, and marking of 900 female elk in Rocky Mountain National Park, considering the terrain and the free-ranging nature of the elk, would be significantly more difficult than this, and well beyond the financial, logistical, and operational abilities of the park, especially given the many concurrent demands on park resources and funding. In addition, the ability to capture and treat 900 female elk each year would decline over time as elk would become more wary of management actions, reducing the ability for this alternative to meet the long-term management objectives of the plan. To prevent births in the following year, treatment would occur between August and September when visitation to the park is high. The impacts on visitors from a high number of elk that would bear a marking and the high frequency of management actions in the summer months would result in a significant level of adverse impacts on visitors that could be reduced via alternate management actions.

As fertility control agents improve and technologies advance in the ability to administer agents in the wild, the ability of the National Park Service to achieve population objectives solely with fertility control agents increases. Alternative 4 relies on fertility control to the maximum extent feasible; however, until a longer-lasting agent becomes available for use in wild, free-ranging populations, the use of short-term fertility control agents would be supplemented with lethal reduction actions. If during the life of the plan a multi-year fertility control agent becomes available, the National Park Service would manage the elk population size using only fertility control under Alternative 4 and could use it as a means of elk population control in an adaptive manner under Alternative 3.

Self-sustaining Wolf Population: This alternative would have reestablished wolves in the park and would have allowed their population to self-regulate. There would have been no limits imposed on wolf population growth or distribution. Without active management of the population, wolves would have been expected to disperse from the park as their numbers increased over time. Without support of agencies within the region to protect wolves from depredation outside the park, there would be no assurance that a wolf population would survive. This alternative has been dismissed from further consideration because of a lack of support from other agencies within the region; concerns by neighbors related to perceived and real threats to property and safety; the degree of expected human property-wolf conflicts; and the intensive management that would be required to respond to external issues, such as social impacts, would likely interfere with the ability to meet the objectives of the plan.

As stated earlier in this chapter, the National Park Service would consider the use of a highly managed wolf population under the preferred alternative, Alternative 3, as an adaptive tool if opportunities were present to cooperate with adjacent land managers and the State of Colorado, and if supported by state and federal policy. The park would also work with other federal, state, and local agencies on regional wolf issues such as natural wolf recolonization or a regional restoration effort as described in the "Elements Common to All Alternatives: Natural Wolf Recolonization" section.

SELECTION OF THE PREFERRED ALTERNATIVE

Since publication of the draft plan/EIS and receipt and analysis of public comments, the National Park Service has re-evaluated the alternatives in determination of a preferred alternative. Alternative 3 has been defined as the National Park Service preferred alternative in the final plan/EIS based on the rationale provided below.

Selection of the preferred alternative is based on the overall ability of the alternative to meet park objectives, support the purpose of the park, and minimize adverse effects on the resources of the park while providing for public use and enjoyment. Although other action alternatives would also meet these criteria, a number of additional factors were considered in the selection of the preferred alternative.

The National Park Service has given consideration to the expected availability of funds to implement the plan and has determined that to meet the objectives of the plan/EIS within forecasted available funds, population reduction activities would need to be conducted gradually. In comparison to Alternative 2, which would involve a high level of reduction of elk early in the planning period, Alternative 3 would reduce the elk population at a more gradual rate over 20 years. This more gradual approach to population reduction could be conducted within existing operations and capabilities and through existing funding sources. This would considerably reduce the cost of the plan compared to Alternative 2, which would require contractors due to the intensive reduction activities in the first four years of the plan.

The elk population reduction methods associated with Alternative 3 would have a high degree of certainty of being successful, and implementation would be less complex compared to Alternatives 4 and 5. Alternative 3 would have a greater level of effectiveness with less time and resources dedicated to implementation than Alternative 4, which emphasizes the use of fertility control agents and Alternative 5, which would use a highly managed wolf population. Alternative 4 would have substantial logistical challenges associated with treating large numbers of female elk with the short-term fertility control agent that is currently available for use. Alternative 5 would also present logistical challenges and require significantly higher levels of park resources to continuously monitor and manage a wolf population that would be maintained within the park boundaries. Due to the experimental nature of Alternative 5 in using a highly managed wolf population, there is a greater level of uncertainty in successfully controlling the elk population and meeting vegetation objectives under this alternative.

In addition, a gradual reduction in the elk population over time would result in less impact on visitor use and experience and result in no long-term economic loss. Although Alternative 3 may require temporary closures resulting from reduction activities of small areas on the elk range, the smaller-scale reduction actions would be less frequent and for shorter periods of time, and less noise would be produced when compared to the reduction activities associated with Alternative 2 and potentially with Alternative 5.

HOW ALTERNATIVES MEET THE OBJECTIVES

As stated in the "Purpose of and Need for Action" chapter, all action alternatives selected for analysis must meet all objectives to a large degree. The action alternatives must also address the stated purpose of taking action and resolve the need for action; therefore, the alternatives and the effects they would have on park resources in the project area were individually assessed in light of how well they would meet the objectives for this plan/EIS. Alternatives that did not meet the plan/EIS objectives were rejected as inappropriate (see the "Alternatives Eliminated from Further Consideration" section in this chapter).

Table 2.2 summarizes the elements of the alternatives being considered. Table 2.3: Analysis of How the Alternatives Meet the Objectives compares how each of the alternatives described in this chapter would meet the objectives for this plan/EIS. The "Environmental Consequences" chapter describes the effects on each impact topic under each of the alternatives, including the impact on recreational values and visitor experience. These impacts are summarized in Table 2.4: Summary of Environmental Consequences. (Tables 2.2, 2.3, and 2.4 are at the end of this chapter.)

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is the alternative that will best promote national environmental policy expressed in the National Environmental Policy Act (NEPA). Section 101(b) of NEPA identifies six criteria to help determine the environmentally preferred alternative. The act directs that federal plans should:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;
3. Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
4. Preserve important historical, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
5. Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

The environmentally preferred alternative would cause the least damage to the biological and physical environment, and would best protect, preserve, and enhance historical, cultural, and natural resources. Alternative 5 is considered the Environmentally Preferred Alternative in its ability to best meet the six national environmental goals.

1. All of the action alternatives would meet goal 1 as they would restore the elk and vegetation on the elk range to what would be expected under natural conditions. This would provide for continued enjoyment of these resources in the park for future generations. All of the action alternatives would restore vegetation within the park so that it functions as natural communities providing habitat for a large diversity of wildlife species. Alternative 1, continuing current management, would result in impairment of aspen and willow communities in the park as it would not reverse the expected long-term continued degradation of montane riparian willow and aspen. In the long-term, there would be an inability for enjoyment of these resources by future generations.
2. All of the action alternatives would meet goal 2 to varying degrees with Alternative 5 meeting it to the largest extent. All of the alternatives would improve the vegetation condition of the elk range and ensure that aspen would be present for the enjoyment of visitors. However, Alternatives 3 and 4 would use fences on the primary elk range to protect montane riparian willow that would obstruct to a minor level the viewshed, which some visitors would find aesthetically displeasing. In addition, the recovery of vegetation on the landscape would represent an unnatural state as areas in fences would recover to a level higher than expected with natural levels of herbivory. Alternative 2 and 5 would fulfill this goal to a large degree, as they would not use willow fences to protect vegetation on the primary winter range and vegetation would be restored across the landscape reflective of natural conditions. Alternative 5 would do this to a greater degree as the distribution of elk by wolves is what would be expected under natural conditions. The least amount of aspen fencing is expected to be needed under Alternative 5. In addition, the presence of wolves in

the park under Alternative 5 would increase visitor appreciation of the park. Alternative 1 would not meet this goal as the vegetation condition on the elk range would continue to degrade and aspen would be lost on the landscape which would adversely affect visitor appreciation of the park.

3. All of the action alternatives would improve public health and safety inside the park by reducing elk abundance, densities, and habituation to humans. This would result in decreased potential for human-elk conflict such as vehicle accidents and property damage. However Alternatives 2 and 5 would achieve this goal to a larger degree. Alternative 2 would reduce the elk population to a lower level and through use of lethal controls, aversive conditioning, and herding, would decrease densities of elk and as a result increase elk wariness of humans, reducing the potential of human-elk conflict. Alternative 5 meets this goal to the greatest degree, as wolves would be more effective in reducing elk densities and would also increase elk wariness reducing their habituation to humans and developed areas. Alternative 1 would not meet this goal as elk densities and abundance would remain high and elk would continue to become habituated to developed areas thereby increasing the potential for human-elk conflicts.
4. All of the action alternatives meet goal 3 by restoring the vegetation on the elk range to reflect natural conditions and preventing the loss of important habitat that supports a large variety of wildlife species. The action alternatives therefore maintain the wide variety of resources within the park for the enjoyment of visitors. Alternative 5 would meet this goal to an even greater degree as wolves would be present within the park, increasing even further the diversity of resources and activities within the park for visitor enjoyment. Alternative 1 would not meet this goal, as vegetation on the elk range which supports a diversity of species would be degraded and aspen would be lost, thereby reducing the diversity of resources and activities enjoyed by visitors.
5. The action alternatives would meet this goal to varying degrees. All of the action alternatives would restore elk and vegetation on the elk range to reflect natural conditions that would continue to be enjoyed by visitors. The reduction in elk abundance and densities under the action alternatives would also reduce elk habituation to developed areas providing enhanced protection of public safety and property. These results increase the balance between the public's use and appreciation of the park and the surrounding area and the resources. Alternative 5 would meet this goal to a lesser degree however due to the potential for wolf depredation on livestock or domestic animals, which would not represent a balance between population and resource use in the area. Alternative 1 would not meet this objective as vegetation within the elk range would continue to be degraded and aspen would be lost. Continued high levels of elk abundance and densities would increase conflict between visitors to the park and residents in surrounding areas that would not represent a balance between the population and resource use.
6. Enhancing the quality of renewable resources recycling of depletable resources is not applicable to the management of elk and vegetation within the park.

TABLE 2.2: SUMMARY OF ALTERNATIVE ELEMENTS

Alternative Actions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Target elk population range	Population would fluctuate between 2,200 and 3,100 animals; however, it could rise above or drop below this range due to variables such as weather, emigration, or immigration.	The target population range would be at the low end of the range of natural variation. Population would fluctuate between 1,200 and 1,700 animals (200 to 400 park subpopulation; 1,000 to 1,300 town subpopulation).	The target population range would be at the high end of the range of natural variation. Population would fluctuate between 1,600 and 2,100 animals (600 to 800 park subpopulation; 1,000 to 1,300 town subpopulation).	The target population range would be at the high end of the range of natural variation. Population would fluctuate between 1,600 and 2,100 animals (600 to 800 park subpopulation; 1,000 to 1,300 town subpopulation).	The target population range would be broad and fluctuate within the natural range of variation. Population would fluctuate between 1,200 and 2,100 elk (200 to 800 park subpopulation; 1,000 to 1,300 town subpopulation).
Elk population reduction	No management of elk would occur inside the park. Elk population would fluctuate according to forage availability and weather conditions supplemented by hunting that occurs outside the park.	The elk population would be reduced by lethal reduction (culling) by NPS personnel and their authorized agents. In the first four years, approximately 200 to 700 elk would be removed each year. In the last 16 years, approximately 25 to 150 elk per year would be removed to maintain the population. The number of elk removed annually would be determined based on monitoring.	The elk population would be reduced by lethal reduction (culling) by NPS personnel and their authorized agents. Up to 200 elk would be lethally removed each year. The number of elk removed annually if any would be determined based on monitoring.	The elk population would be reduced through a combination of fertility control and lethal reduction actions (culling) by NPS personnel and their authorized agents. Using a single-year agent, 400 elk per year would be treated in the first four years of the plan and 200 per year in the remaining 16 years. In addition, approximately 80 to 150 elk would be lethally removed each year. The number of elk that would be treated with multi-year or life-time duration agents is unknown. The number of elk treated and/or removed annually would be determined based on monitoring.	The elk population would be reduced through a combination of wolves and lethal reduction actions (culling) by NPS personnel and their authorized agents. In Phase 1, two pairs of wolves would be released. In Phase 2, if necessary, wolves would gradually increase up to 14. Lethal reduction would remove 50 to 500 elk per year in the first four years and in the remaining 16 years, up to 100 elk would be lethally removed each year to maintain the population, if needed. The number of elk removed annually if any would be determined based on monitoring. Wolf movement and activity would be continuously monitored and their activities restricted to within the boundaries of the park.

TABLE 2.2: SUMMARY OF ALTERNATIVE ELEMENTS (CONTINUED)

Alternative Actions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Euthanasia or capture facility	No active management of the elk population would occur inside the park; therefore, there would be no use of a euthanasia or capture facility.	A temporary capture facility could be used during the reduction phase to efficiently remove a high number of elk to meet population targets.	Because of the lower number of elk that would need to be lethally removed each year, a capture facility may not be needed but could be used adaptively.	A temporary capture facility could be used adaptively to treat and mark elk treated with a fertility control agent and for lethal reduction actions.	A temporary capture facility could be used during the reduction phase to efficiently remove a high number of elk to meet population targets.
Herding (directed movement of elk)	No active management of the elk population would occur inside the park; therefore, no herding would occur.	Herding using trained herding dogs, riders on horseback, people on foot with noisemakers or visual devices, and if necessary, helicopters could be used adaptively to encourage elk migration from the primary winter range to the primary summer range, to move elk from the Kawuneeche Valley to areas outside the park where they could be hunted, and to direct elk to a capture facility during the reduction phase to efficiently remove a high number of elk.	Herding using trained herding dogs, riders on horseback, people on foot with noisemakers or visual devices, and if necessary, helicopters could be used adaptively to encourage elk migration from the primary winter range to the primary summer range and to move elk from the Kawuneeche Valley to areas outside the park where they could be hunted. These methods may also be used to move elk into a capture facility, although the need for an elk capture facility is less likely under this alternative.	Herding using trained herding dogs, riders on horseback, people on foot with noisemakers or visual devices, and if necessary, helicopters could be used adaptively to encourage elk migration from the primary winter range to the primary summer range and to move elk from the Kawuneeche Valley to areas outside the park where they could be hunted. If a capture facility is needed to administer and mark elk with fertility control agents and for lethal reduction actions, herding may be used to direct elk to the capture facility.	Same as Alternative 2 for the movement of elk into a capture facility, although the need for an elk capture facility is unlikely.
Aversive conditioning (used to disperse concentrations of elk)	Agency staff could use aversive conditioning to move elk that are exhibiting aggressive behavior.	Same as Alternative 1. In addition, aversive conditioning as with rubber bullets, cracker shot, visual devises, trained herding dogs, people on foot, riders on horseback, or noisy weapons could be used as needed to prevent excessive concentrations of elk in unfenced areas.	Same as Alternative 2. However, aversive conditioning would be used more frequently to prevent excessive concentrations in unfenced areas.	Same as Alternative 3.	No aversive conditioning of elk would be needed as wolves would effectively redistribute the elk.

TABLE 2.2: SUMMARY OF ALTERNATIVE ELEMENTS (CONTINUED)

Alternative Actions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Fences	Approximately 12 acres of montane riparian willow, aspen, and herbaceous and upland shrub vegetation are fenced for research purposes. Fences are also used to a limited extent to protect plants in landscaped areas.	Same as Alternative 1. In addition, 160 acres of aspen habitat could be fenced on the elk range to protect aspen stands from elk herbivory as needed, based on monitoring of vegetation response to management actions.	Aspen habitat would be fenced the same as Alternative 2. 260 acres of suitable montane riparian willow could be fenced on the elk primary winter range and 180 acres on the primary summer range. Fences would be installed commensurate with elk reductions and in a phased approach based on monitoring of vegetation response to management actions.	Aspen habitat would be fenced the same as Alternative 2. 260 acres of suitable montane riparian willow habitat could be fenced on the elk primary winter range. Fences would be installed commensurate with elk reductions and in a phased approach based on monitoring of vegetation response to management actions.	Same as Alternative 2, but with less fencing expected to be necessary.
Chronic wasting disease prevalence testing	Animals suspected of having chronic wasting disease are lethally removed and tested. When possible, elk carcasses found are removed and tested for chronic wasting disease to indicate trends.	Same as Alternative 1. In addition, all adult elk that are lethally removed would be tested for chronic wasting disease. If a field test became available that allowed immediate live testing for chronic wasting disease, captured elk would be tested and those testing positive for the disease would be removed.	Same as Alternative 2, although the number tested would be less due to the lower number of elk removed over time.	Same as Alternative 2, although the number tested would be less due to the lower number of elk removed over time and may decline over time if an effective, multi-year, fertility control agent is developed and management of the population would be predominantly through fertility control activities rather than lethal reduction. If a field test became available that allowed immediate live testing for chronic wasting disease and fertility control involves capture, elk would be tested and those testing positive for the disease would be removed.	Same as Alternative 2, although the number tested would be less due to the lower number of elk removed over time and could decline over time as management of the population may be predominantly through wolf activities and predation rather than lethal reduction, although wolf killed elk would be tested.

TABLE 2.2: SUMMARY OF ALTERNATIVE ELEMENTS (CONTINUED)

Alternative Actions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Distribution of carcasses	Targeted chronic wasting disease-suspect carcasses are disposed of appropriately through incineration or chemical digestion.	Same as Alternative 1. In addition, most elk carcasses resulting from lethal reduction actions would be removed from the field. Some carcasses may be left in the environment and the number would reflect a natural state to the greatest extent possible. The National Park Service would identify interested organizations, agencies, and/or tribes to partner with in a meat donation program to defer program costs. Carcasses and/or meat would be donated to the extent possible or carcasses would be disposed of appropriately (incineration, chemical digestion, or landfill).	Same as Alternative 2, although the number of elk carcasses would be less in years 1 through 4.	Same as Alternative 2, although the number of elk carcasses would decline if management could rely more on fertility control.	Same as Alternative 2, although the number of elk carcasses would decline if wolves increase management of the elk population.
Vegetation restoration methods to stimulate aspen and/or willow regeneration	No additional vegetation restoration methods would be employed.	Vegetation restoration methods (prescribed burning, mechanical vegetation removal, active planting of willow cuttings) would be employed once aspen and montane riparian willow are adequately protected from excessive browsing. In fenced aspen areas, these methods would be employed sooner than in areas that are unfenced.	Same as Alternative 2, although methods could be employed sooner in fenced areas.	Same as Alternative 3 in aspen habitat on the primary elk range and in suitable montane riparian willow habitat on the primary winter range.	Same as Alternative 2.
Beaver reintroduction	Beaver would not be actively reintroduced within areas of the elk range.	If beavers do not naturally recolonize, they would be reintroduced into suitable habitats once montane riparian willow recovery is adequate to support a colony indefinitely.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

TABLE 2.2: SUMMARY OF ALTERNATIVE ELEMENTS (CONTINUED)

Alternative Actions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Monitoring	Elk numbers and distribution are monitored on a yearly basis using aerial and ground surveys. The status of potential natural wolf recolonization is monitored. The status of beaver populations is monitored.	In addition to the monitoring conducted under Alternative 1, monitoring would be conducted for the following parameters: More frequent elk population size, composition, and distribution. Condition of aspen, montane riparian willow, and herbaceous vegetation in terms of structure, regeneration, and cover. Informal and/or formal surveys to determine visitor response to elk and vegetation management activities.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2. In addition, activities and movements of released wolves would be monitored continuously. Wolf kills would also be monitored for chronic wasting disease. Informal and/or formal visitor surveys could also be conducted to determine how the potential to hear and see wolves may have changed visitor experience.
Opportunistic research activities	No management of elk would occur inside the park and therefore no opportunistic research activities would occur.	Within the first few years of management, research activities would be conducted involving up to 120 elk to evaluate a live chronic wasting disease test and the effectiveness of a multi-year fertility control agent.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Education	No enhancements to current education or interpretive programs.	Additional public information would be developed and provided to the visitor on the role of elk in the environment and the potential safety risks and changes in the visitor experience associated with elk management actions.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2. In addition, public information would be developed to educate the public on the role of elk and wolves in the environment and potential safety risks associated with wolves.
Estimated costs					
One-Time Costs		$972,000	$2,174,100	$1,569,100	$763,250
Annual costs (Years 1 – 4)		$1,099,061	$212,055	$655,370	$1,232,754
(Years 5 – 20)		$211,755	$212,055	$423,370	$599,421

TABLE 2.3: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES

Objectives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Restore and/or maintain the elk population to what would be expected under natural conditions, to the extent possible. Maintain a free-roaming elk population. Decrease the level of habituation. Restore the elk population size in order that it fluctuates within the natural range of variation, between 1,100 and 2,100 elk. Redistribute elk to reflect a more natural state.	Does not meet objective. The elk population would continue to be less migratory, more sedentary, and less vigilant as elk would be able to forage for longer periods and in high concentrations in locations that do not pose threats or stress. Elk densities would continue to be high on the core winter range. The elk population size would continue to be outside the natural range of variation ranging between 2,200 and 3,100 elk.	Fully meets objectives. Elk would be forced off the primary winter range to ensure that most elk migrate to summer range. This would represent a return to behavior more typically associated with seasonal elk movements. Elk would be more migratory and less sedentary. Redistribution actions and lethal control activities would cause elk to be more wary of people and reduce over-concentration of elk in certain areas of the park which would reflect a more natural condition. The elk population would fluctuate between 1,200 to 1,700 elk, which would be on the lower end of the natural range.	Meets objectives to a large degree but would take longer to achieve than Alternative 2. The effects of Alternative 3 on behavior in the elk population would be similar to those described for Alternative 2. However, elk would be excluded from fenced areas of their range, which would be an unnatural condition. The elk population would fluctuate between 1,600 to 2,100 elk, which would be on the higher end of the natural range.	Meets objectives to a large degree the same as described for Alternative 3.	Fully meets objectives. The presence of wolves on the primary winter range in summer would encourage elk migration to traditional summer elk range at higher elevations. The presence of wolves, combined with the effects of lethal reduction activities, would make elk in the park more wary and would reduce the densities of elk, particularly in the core winter range. This would result in more natural elk distributions. The elk population would fluctuate within the natural range of variation between 1,200 to 2,100 elk.

TABLE 2.3: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES (CONTINUED)

Objectives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Restore and/or maintain the natural range of variation in vegetation conditions on the elk range, to the extent possible. Prevent loss of aspen clones within high elk use areas. Restore and maintain sustainable willow. Increase willow cover within suitable willow habitat on the primary winter range. Maintain or improve the condition of willow on the primary summer range. Reduce the level of elk grazing of herbaceous vegetation.	Does not meet objective. Vegetation on the elk range would continue to be adversely affected to a large degree because the elk population size would remain large and over - concentrated, and less migratory. With continued high levels of elk herbivory, aspen would not be able to regenerate in high elk use areas of the elk range. The older trees that are present would continue to be lost due to mortality leading to further reductions in overall stand sizes on the primary winter range. Continuing current high levels of elk herbivory and absence of beaver would result in an inability of willow to regenerate particularly in areas of the core winter range resulting in further reductions in willow distribution and localized loss of willows.	Fully meets objectives. The rapid reduction in elk numbers and increased distribution and migration of the population and the protection of aspen stands of the elk range with fences would result in large reductions in elk herbivory on the elk range in a short period of time. This would facilitate community level changes toward a more natural condition. The loss of aspen stands on the elk range would be prevented and recovery would occur as aspen regeneration, stand size and complexity, and cover would be increased to a large degree. With a large reduction in elk population, increased dispersal of the population, and increased water table as a result of beaver recovery or reintroduction, willow reproduction, seedling establishment, height,	Meets objectives to a large degree. Within fenced areas of aspen and willow, the objectives for vegetation restoration and recovery would be fully met as described in Alternative 2. The recovery of vegetation outside of fenced areas on the elk range would be less and would take longer to achieve as the elk population target is at a higher level and reduction is slower compared to Alternative 2. In addition, the recovery of vegetation across the landscape would be less reflective of natural conditions as fenced areas would recover more fully and rapidly compared to unfenced areas and there would not be a patchy distribution of vegetation reflective of the condition that would occur naturally with the presence of predators.	Meets objectives to a large degree as described in Alternative 3. Without fences to protect willow on the primary summer range, the recovery of vegetation in this area would be more reflective of natural conditions in terms of patchiness across the primary summer range landscape; however the level of recovery would likely be less in comparison to alternatives that involve the use of fences, wolves, and/or a lower elk population size.	Fully meets objectives. The reduction in elk numbers and increased distribution and migration of the elk population as a result of the activities of wolves, as well as lethal reduction and the protection of aspen stands on the elk range, would result in vegetation recovery as described in Alternative 2. The recovery of vegetation across the landscape would be most representative of the natural condition.

TABLE 2.3: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES (CONTINUED)

Objectives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
(continued)	Elk would continue to remain on the primary winter range year round further impacting vegetation during the growing season.	volume, and cover on the elk range would increase. As a result, the abundance and distribution of willow on the elk range would increase. Large reductions in elk herbivory would result in reduced levels of grazing of herbaceous vegetation. Recovery of vegetation across the landscape would be reflective of natural conditions.			
Opportunistically collect information to understand chronic wasting disease prevalence in the park within the framework of the plan.	Fully meets objective. Monitoring for chronic wasting disease-infected animals within the park would continue to occur year-round, but would be limited to intermittently available carcasses that result from natural mortality, chronic wasting disease death, road kills, or lethal removal of infected elk.	Fully meets objective. In the early years, lethal reduction operations would produce elk carcasses in sufficient numbers to collect information to understand chronic wasting disease prevalence within the Rocky Mountain National Park / Estes Valley population.	Fully meets objective. Opportunities to collect information would be similar to Alternative 2, but somewhat fewer elk would be lethally removed.	Fully meets objective. Opportunities to collect information would be the same as Alternative 3.	Fully meets objective. Opportunities to collect information would be similar to Alternative 2 in the early years, but may decrease as wolves become more responsible for elk population regulation, although monitoring wolf killed elk would also occur.

TABLE 2.3: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES (CONTINUED)

Objectives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Ensure that strategies and objectives of this plan/EIS are not in conflict with those of chronic wasting disease management.	Meets objective to some degree. The continued high densities of elk would contribute to a higher likelihood of transmission of chronic wasting disease in the elk population. The sedentary nature of ungulates on their primary winter range and tendency to congregate in large herds may increase the probability of contact with sources of infection that reside in the environment. This would continue to occur under this alternative which is inconsistent with chronic wasting disease objectives. Monitoring for chronic wasting disease-infected animals and removing carcasses that may increase environmental contamination within the park would continue to occur year-round. This would continue to be consistent with chronic wasting disease management objectives.	Fully meets the objective. Lowering the size and density of elk population could potentially lower the prevalence of chronic wasting disease. Additionally, a less sedentary elk population and localized dispersal of highly concentrated elk would help lower the risk of disease transmission. Monitoring for chronic wasting disease would greatly increase because there would be a large number of carcasses available.	Fully meets the objective. The effects of Alternative 3 on the prevalence of chronic wasting disease in the elk population and monitoring activities would be similar to those for Alternative 2. Because of the gradual reduction of the elk population to the higher end of the natural range, the time to fully achieve the objective would be longer.	Fully meets the objective as described in Alternative 3.	Fully meets the objective. Wolves may prey on weaker, diseased elk than stronger, healthy elk. If this were to happen, selective predation on elk with chronic wasting disease would remove a higher proportion of diseased animals from the population. Monitoring would be the same as under Alternative 2.

TABLE 2.3: ANALYSIS OF HOW ALTERNATIVES MEET OBJECTIVES (CONTINUED)

Objectives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Continue to provide for elk viewing opportunities.	Fully meets objective. Because elk in and around the park would remain plentiful and habituated, visitors would continue to have abundant opportunities to view elk, often from the convenience of their cars.	Meets objective to a large degree. Fewer elk that are more wary of humans would somewhat reduce viewing opportunities in the park, including at the large meadows bisected by the main roads. Despite this reduction, visitors would continue to have many opportunities to view elk, including during the fall rutting season.	Meets objective to a large degree. Effects on visitors due to management of the elk population would be similar to those of Alternative 2. However, target elk population numbers would be achieved more gradually, and the overall reduction would be less than Alternative 2. Visitors would therefore be less likely to notice elk management activities or effects.	Meets objective to a large degree. Visitor opportunities to view elk would be the same as described in Alternative 3.	Meets objective to a large degree. Visitor opportunities to view elk would be the same as under Alternative 3 except elk would be more dispersed. There would be continued elk viewing opportunities in large meadows. Visitors would have the opportunity to see elk and other wildlife in a more natural setting similar to Alternative 2.
Recognize the natural, social, cultural, and economic significance of the elk population.	Meets objective to a large degree. The existence of the elk population would continue to recognize the social and cultural significance of the elk by providing view opportunities for those individuals and tribes that value elk. Associated economic gains would continue in the area. The elk population size and distribution and associated habitat conditions would continue to be outside the range of natural variation; reducing the park's ability to meet it's mission to maintain or restore the natural ecosystem.	Fully meets objective. The ability to view elk would continue to provide social benefits to the visitor and associated economic gains would continue. The maintenance of the elk population would provide cultural benefits to tribes who value the elk as part of their history. Managing elk and associated habitat conditions within the natural range of variation improves the park's ability to meet its mission and fully recognize the natural significance of elk in the ecosystem.	Fully meets objective as described in Alternative 2.	Meets objective to a large degree similar to that described in Alternative 2. However, the use of fertility control agents reduces the natural significance of the elk population and the use of visible markings to indicate elk that have been treated with a fertility control agent would adversely affect elk viewing opportunities.	Fully meets objective as described in Alternative 2. However this alternative would best reflect natural conditions of elk distribution and habitat condition on the elk range with the release of wolves. This would improve to the greatest extent the park's ability to meet it's mission and fully recognize the natural significance of elk in the ecosystem.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Elk Population	The size and density of the elk population would represent long-term, local and range-wide, moderate, adverse effects. The less migratory, more sedentary, and less vigilant elk population represents a long-term, local to range-wide, moderate, adverse effect. Habituation to humans and the potential for human-elk conflict would continue to pose long-term, regional, and negligible-to-moderate effects. High densities would continue to have adverse effects on body condition and energy expenditures, resulting in long-term, local, adverse, and moderate effects. Annual aerial monitoring would result in annual, short-term, winter-range-wide, minor, adverse effects. The increased potential for transmission of chronic wasting disease	Maintenance of aspen, restoration of riparian willow communities, and the return of beaver with a subsequent increase in surface water would represent a long-term, local-to-range-wide, moderate, beneficial effect. Fencing of aspen would represent a long-term, local, minor adverse effect. The reduced elk population size and densities would represent a long-term, range-wide, moderate benefit. Reversal of the trend toward a less migratory population would represent a long-term, range-wide, moderate benefit. Redistribution actions, lethal reduction actions, and research activities would reduce the level of habituation to humans, resulting in a moderate beneficial effect, as would the effects associated with lethal reduction actions or the use of a capture facility. Alternative 2 would increase the bull:cow ratio, a theoretical minor	Decreased foraging pressure from fencing in riparian willow would result in a long-term, local, minor-to-moderate benefit. The reduced elk population size and densities would have effects similar to but incrementally less than the long-term, range-wide, moderate benefit described for Alternative 2. Disturbance associated with installation of fences in aspen and riparian willow would have a short-term, local, negligible-to-minor, adverse effect. Restricted availability of habitat would have a long-term, minor, adverse effect. Effects on elk behavior and the population's age and sex structure would be similar to those described for Alternative 2. Effects on body condition and energetics would be the same as Alternative 2 but incrementally greater because of the increased use of redistribution activities and fences.	The effects on elk habitat would be the same as those described for Alternative 3: long-term, local, minor-to-moderate benefit. The long-term, range-wide, moderate, beneficial effects on population size and density would be the same as described for Alternative 3. Lethal reductions, redistribution, research activities, and remote administration of the fertility control agent (i.e., darting) would positively affect elk behavior and migration tendencies and reduce habituation producing long-term, range-wide, moderate benefits. Affects on age and sex composition would be long-term, range-wide, minor benefits. Increased energy expenditures by bull elk in a two-week longer rut if Leuprolide were used would have negative effects on individual elk. Stress and energy expenditure	The benefits to elk habitat would be long term, local to range-wide, and moderate to major as a result of redistribution of elk by wolves and the range-wide effects on habitat conditions. The effects on elk population size and density would be long-term, range-wide, moderate benefits. Wolves' effect on elk density would be long term, local, moderate, and beneficial. Decreased habituation to humans, increased wariness and wildness, and decreased sedentary behavior would be long term, local, minor-to-moderate, and beneficial. Increased elk movements would represent a long-term, range-wide, moderate benefit. Increased fitness of the elk population would be a long-term, range-wide, minor-to-moderate benefit.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Elk Population (continued)	would be a long-term, regional, moderate, adverse effect on the population. Alternative 1 would generally contribute long-term, adverse effects on the elk population ranging up to major. These effects contribute to the overall adverse cumulative effects of other past, present, and future actions, but do not result in an adverse cumulative effect greater than moderate. Alternative 1 would not result in impairment.	benefit. Management actions associated with lethal reduction activities, herding, overflights, research activities, and other potentially disturbing actions would increase stress and energy expenditures in individual elk. In the long-term, the management action would reduce competition and energy expenditures for forage in the population representing an overall net moderate benefit. Reducing the potential for transmission and prevalence rate for chronic wasting disease would be a minor benefit. Overall, Alternative 2 would have a long-term, local-to-range-wide, moderate, beneficial effect on the elk population. The overall cumulative effects of other plans, projects, and actions combined with the effects of Alternative 2 would include short-term, minor adverse impacts and long-term, local-to-range-wide, minor-to-moderate	In the long-term, reduced competition and energy expenditures for forage and habitat would result in an overall minor net benefit. The effects with respect to the prevalence of chronic wasting disease would be a long-term, range-wide, minor benefit. The overall beneficial effect of the management actions associated with Alternative 3 on the elk population would be long-term, local, and moderate. The overall cumulative effects of Alternative 3 would be similar to the short-term, minor adverse impacts and long-term, range-wide, moderate benefits of Alternative 2, with a small decrease in the benefits to the elk population because	associated with capture would have negative effects on individual elk. In the long-term, reduced competition and energy expenditures for forage and habitat would result in an overall minor net benefit. The effect on the prevalence of chronic wasting disease would be a long-term, range-wide, minor benefit. Balancing the various positive and negative effects of the management actions and research activities, the effects of Alternative 4 would be long term, local to range-wide, minor to moderate, and beneficial. Cumulative effects of Alternative 4 would be the same as described for Alternative 3. Alternative 4 would not result in impairment.	Effects on the age and sex composition of the elk population would be similar to those described for Alternative 2. Short-term effects associated with lethal reduction and research activities would be local, minor-to-moderate, and adverse. In the long term, a smaller and less dense elk population combined with increased fitness resulting from wolves would represent a range-wide, moderate benefit. Wolves would preferentially prey on young, old, weak, and diseased elk, potentially reducing the prevalence of chronic wasting disease, a long-term, range-wide, minor-to-moderate benefit. Alternative 5's contribution to the

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Elk Population (continued)		benefits. Alternative 2 would not result in impairment.	Alternative 3 would not realize benefits as quickly as Alternative 2. Alternative 3 would not result in impairment.		overall cumulative impacts on the elk population would be similar to those described for Alternative 2, although the release of the gray wolf would have additional short-term and long-term adverse effects for elk, as well as long-term, range-wide, cumulative benefits that would be incrementally greater than the benefits associated with Alternative 2. Alternative 5 would not result in impairment.
Vegetation	Expected continuing high levels of elk herbivory and potential loss of aspen would have a long-term, major, adverse impact. An inability to use prescribed fire would be a major, long-term, adverse effect. The continued reduction and survivorship of montane riparian willow would result in long-term, major, adverse impacts.	This alternative would facilitate community-level changes toward a more natural condition. The protection provided to aspen from elk herbivory would be a long-term, major, beneficial effect. The ability to use fire and other restorative actions within aspen stands would be a major, long-term benefit.	This alternative would facilitate gradual, community-level changes toward a more natural condition. Protecting aspen with fences and reduced elk herbivory would result in long-term, major benefits. The ability to use fire and other restorative actions within aspen stands would be a major, long-term benefit.	This alternative would facilitate gradual, community-level changes toward a more natural condition. The protection of aspen stands would result in major, long-term benefits as described in Alternative 3.	This alternative would facilitate community-level changes toward a more natural condition. Reduced elk population size, increased elk movements, and changed elk grazing patterns would result in long-term, major benefits for aspen.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Vegetation (continued)	The continued inability to use fire to stimulate regeneration would have long-term, major, adverse effects. The adverse effects on upland and riparian herbaceous vegetation would be long-term and moderate in areas where elk concentrate. The long-term effects on bitterbrush and sagebrush upland shrubs would be moderately adverse. Changes in individual species abundance would result in long-term minor, adverse impacts. Continued adverse effects on subalpine and alpine willow would range up to major. The adverse effects on subalpine and alpine herbaceous vegetation would be minor and long-term. The long-term, adverse effects of exotic plant species as a result of elk herbivory would be negligible to minor.	The recovery of montane riparian willow across the landscape would be patchily distributed, reflective of natural conditions. The increase in abundance, competitive ability, survivorship, and conversion to taller montane riparian willow would result in long-term, major, beneficial impacts. Vegetation recovery methods would have long-term, major, beneficial effects. The long-term beneficial effects on upland and riparian herbaceous vegetation would be minor to moderate. The conversion of herbaceous habitat to montane riparian willow would represent a minor-to-moderate, adverse effect. The long-term, beneficial effects on shrub species would be moderate. Increases in individual species abundances would result in long-term, minor, beneficial effects. Increased mule deer population and	In fenced areas, montane riparian willow would transform from shorter willow to taller willow, increase in cover, and survivorship, a major, long-term benefit. Outside fenced areas the plan would result in long term, moderate benefits to montane riparian willow. With adaptive management, the overall long-term benefit would be major. The recovery of montane riparian willow across the landscape would not be representative of natural conditions, as recovery would be more complete in fenced areas. The long-term, adverse effects on herbaceous vegetation in fenced areas would be minor to moderate due to conversion from grassland to shrub habitat, although this would reflect natural conditions. Outside fenced areas, the long- term, beneficial effects would be negligible to minor.	Benefits to montane riparian willow in fenced areas would be long-term and major as described in Alternative 3. Outside fenced areas, benefits to montane riparian willow would be long-term and moderate With adaptive management, the overall long-term benefit would be major. The recovery of montane riparian willow across the landscape would not be representative of natural conditions same as Alternative 3. The long-term, adverse effects on montane riparian herbaceous vegetation in fenced areas would be minor to moderate as described in Alternative 3. Outside fenced areas, the long-term, beneficial effects would be negligible to minor.	The ability to use fire and mechanical vegetation removal actions within aspen stands would be a major, long-term benefit. The recovery of vegetation across the elk range would result in a patchy distribution, most reflective of natural conditions. The increased abundance, competitive ability, and survivorship of montane riparian willow would result in long-term, major, beneficial impacts. The ability to use vegetative restoration tools to improve montane riparian willow regeneration would have long-term, major, beneficial effects. The long-term beneficial effects on upland and riparian herbaceous vegetation would be minor to moderate. The conversion of herbaceous vegetation to willow would represent a minor-to-moderate, adverse effect on herbaceous vegetation; this would reflect natural conditions.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Vegetation (continued)	The cumulative, adverse effects on vegetation would be long-term and moderate to major. Management plans to restore vegetation in the park would result in minor-to-moderate, beneficial cumulative effects. Alternative 1 would result in impairment.	thus herbivory would result in long-term, moderate-to-major, adverse effects. The reduction in disturbance from elk grazing would result in long-term, major, beneficial effects on subalpine and alpine willow and minor benefits on native plant species cover and abundance. The long-term benefit of reducing the potential for exotic plant species infestation would be negligible to minor. In the reduction phase of the plan, agency lethal reduction operations, herding, carcass disposal, installation of fences, and use of temporary capture facilities would result in short- and long-term, minor effects. Effects would be reduced to negligible to minor during the maintenance phase of the plan. Cumulative benefits on aspen, willow, herbaceous, and alpine	The long-term beneficial effects on bitterbrush and sagebrush upland shrub species would be minor. Increased mule deer population and thus herbivory would result in long-term, moderate, adverse effects. Reduced elk herbivory in subalpine and alpine willow habitats would result in long-term, moderate-to-major, beneficial effects, and localized, long-term, minor, beneficial effects on native plant species cover and abundance. The long-term benefit of a reduction in the potential for exotic plant species infestation would be negligible to minor. Effects of localized trampling and loss of individual plants during management activities would be both short-term and long-term and negligible to minor.	The long-term, beneficial effects on bitterbrush and sagebrush upland shrub species would be minor. Increased mule deer population and herbivory would result in long-term, moderate, adverse effects. Reduced elk herbivory in subalpine and alpine willow habitats would result in long-term, moderate-to-major, benefits, and localized, long-term, minor, beneficial effects on native plant species cover and abundance. The long-term benefit of a reduction in the potential for exotic plant species infestation would be negligible to minor. Effects of localized trampling and loss of individual plants during management activities would be both short-term and long-term and negligible to minor.	The long-term, beneficial effects on bitterbrush and sagebrush upland shrub species on the primary winter range would be moderate. Increases in individual species abundances would result in long-term, minor, beneficial effects. Reduced elk herbivory in subalpine and alpine riparian and upland willow and herbaceous habitats would result in long-term, major, beneficial effect on riparian and upland willow and minor benefits to herbaceous vegetation. The long-term benefit of a reduction in the potential for exotic plant species infestation would be negligible to minor. Effects of localized trampling and loss of individual plants during management activities would be both short-term and long-term and negligible to minor.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Vegetation (continued)		vegetation would be moderate-to-major, long-term. Cumulative impacts on upland shrub vegetation would be long-term, major, and adverse. Management plans to restore vegetation in the park would result in overall minor-to-moderate, beneficial, cumulative effects. Alternative 2 would not result in impairment.	The cumulative effects would be moderate-to-major, long-term benefits on aspen, riparian willow, herbaceous, and alpine vegetation. The cumulative effect on upland shrub habitat would be moderate. Management plans to restore vegetation in the park would result in minor-to-moderate, beneficial, cumulative effects. Alternative 3 would not result in impairment.	The cumulative effects would be moderate-to-major, long-term benefits on aspen, riparian willow, herbaceous, and alpine vegetation. The cumulative effect on upland shrub habitat would be moderate. Management plans to restore vegetation in the park would result in minor-to-moderate, beneficial, cumulative effects. Alternative 4 would not result in impairment.	Effects would be reduced to negligible during the maintenance phase of the plan. The cumulative effects would be moderate-to-major, long-term benefits on aspen, riparian willow, herbaceous, and alpine vegetation. The cumulative effect on upland shrub habitat would be long-term, moderate, and beneficial. In other areas of the park, the release of wolves would have minor-to-moderate, beneficial, cumulative effects. Alternative 5 would not result in impairment.
Special Status Species	Changes in habitat would lead to negligible, adverse effects on the greenback cutthroat trout, greater sandhill crane, river otter, and bald eagle; negligible-to-minor, adverse effects on the Colorado River cutthroat trout and Canada lynx; and minor, adverse effects on the wood frog. The boreal toad could experience moderate, adverse effects. The cumulative effects would be short term and	The adverse effects on special status species of elk reduction and redistribution activities and research activities would be short-term and negligible. The benefits that would accrue would be negligible for greenback cutthroat trout, greater sandhill crane, long-billed curlew, bald eagle, and wolverine (decreasing to no effect in the fifth through 20th years for bald eagle and wolverine); minor for river otter, Canada lynx, and wood	Reduction and redistribution activities and research activities would have a temporary, negligible, adverse effect on special status species. Beneficial effects of Alternative 3 would be negligible for the bald eagle or wolverine; negligible for long-billed curlew and greater sandhill crane; negligible to minor forgreenback cutthroat trout, and wood frogs; minor for Colorado River cutthroat trout and Canada lynx; minor	The effects of Alternative 4 on special status species would be beneficial and similar to those described for Alternative 3 except for disturbance effects associated with lethal elk reduction activities, redistribution actions, fence installation activities, and research activities, which would have temporary, negligible, adverse effects. Alternative 4 would have negligible effects on the	The effects of Alternative 5 on special status species would be similar to those described under Alternative 2. Short-term negligible adverse effects would occur from disturbance associated with lethal reduction and research activities; beneficial effects associated with montane riparian willow and aspen habitat recovery would be long-term, park-wide, and negligible.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Special Status Species (continued)	long term, minor, and adverse. Alternative 1 would not result in impairment.	frog; minor-to-moderate for special status species that rely on montane riparian, wetland, and aquatic habitats; and moderate for boreal toad and Colorado River cutthroat trout. The cumulative effects would be long term, negligible to minor, and beneficial as well as short term, minor, and adverse. Alternative 2 would not result in impairment.	to moderate for special status species that rely on montane riparian, wetland, and aquatic habitats; and moderate for boreal toad. The cumulative effects would be long term, negligible to minor, and beneficial as well as short term, minor, and adverse. Alternative 3 would not result in impairment.	greater sandhill crane, bald eagle, and wolverine; negligible to minor benefits for greenback cutthroat trout; minor benefits for long-billed curlew, and river otter, Colorado River cutthroat trout, wood frog, and Canada lynx; minor to moderate benefits for special status species that rely on montane riparian, wetland, and aquatic habitats as a result of beaver restoration or reintroduction; and moderate for the boreal toad. The cumulative effects would be long term, negligible to minor, and beneficial as well as short term, minor, and adverse. Alternative 4 would not result in impairment.	The cumulative effects would be long term, negligible to minor, and beneficial as well as short term, minor, and adverse. Alternative 5 would not result in impairment.
Other Wildlife Species	The range of adverse effects associated with habitat changes would be negligible for bighorn sheep, moose, and bobcat; minor for most small mammals, and fish; minor to moderate for mule deer, butterflies, upland shrub birds, waterfowl and shorebirds; moderate for	Helicopter overflights that would transport fence material into the park and if necessary, to herd elk and remove carcasses would result in a short-term, localized, negative effect on individuals of wildlife species in the area of activity.	The effects on wildlife would be similar to, but in most cases incrementally less than, those described for Alternative 2. Benefits for species strongly associated with montane fenced riparian willow habitat would be long term, local, and minor to moderate.	The effects of implementing Alternative 4 on wildlife would be similar to those described for Alternative 3 on the primary winter range. Benefits for species on the primary winter range strongly associated with montane fenced riparian willow habitat would be	In general, the effects of Alternative 5 are similar to those described for Alternative 2, with some important differences. The benefits would range from negligible to moderate for small mammals; minor for ungulates; negligible to minor for predators, minor

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	amphibians and reptiles; and moderate to major for beaver and for songbirds and cavity nesters. Adverse effects associated with forage competition between elk and white-tailed ptarmigan may occur at a minor-to-moderate intensity. Beneficial effects on wildlife that result from continuing current management would range from negligible to minor for mountain lions and for raptors that forage in grasslands to minor for scavenger species that rely on carrion, including bald and golden eagles.	Negative effects associated with lethal elk reduction actions and carcass removal would result in short-term impacts on wildlife in the form of potential disturbance and temporary displacement. Additional long-term, local, negligible-to-minor adverse effects would be associated with fences around aspen stands for moose and possibly bighorn sheep. Minor-to-moderate, adverse effects on mule deer and upland shrub birds would be associated with increases in the deer population. Use of a capture facility would have up- to- minor adverse effects on wildlife habitat. Research activities associated with procedures to test for chronic wasting disease in live elk and effectiveness of a fertility control agent done in concert with elk management actions would negatively affect individuals of wildlife species while activities were taking place but would not have population-level effects. There would be no effect on other wildlife from fertility	Disturbance from helicopter overflights would have localized negative effects on individuals of wildlife species. Research activities done in concert with elk management activities would have effects the same as Alternative 2. Cumulative effects of other plans, projects, and actions combined with the effects of Alternative 3 would be long-term, moderate, and adverse. Alternative 3 would not result in impairment.	long term, local, and minor to moderate. The use of a capture facility to treat a high number of elk would have short-term, adverse effects on wildlife habitat up to minor in intensity. The administering of fertility control agents for population management and research purposes via darting methods would have negative effects on individuals of other wildlife populations in the vicinity of the activity. Cumulative effects of other plans, projects, and actions combined with the effects of Alternative 4 would be long-term, moderate, and adverse. Alternative 4 would not result in impairment.	to moderate for scavenger species, numerous avian species, fish, amphibians, and reptiles; moderate for beaver; and moderate to major for songbirds, cavity nesting birds, and wildlife habitat in general. The effects of wolf predation would be adverse and minor for individual ungulates, but ultimately, ungulate populations would benefit. Coyote would experience a minor-to-moderate, adverse effect. Minor adverse impacts on upland shrub birds would occur. Research activities done in concert with elk management activities would have effects the same as Alternative 2. Cumulative effects would be short-term, minor-to-moderate, and adverse. Alternative 5 would not result in impairment.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Other Wildlife Species (continued)	Cumulative effects on wildlife would be short- and long-term, minor, and adverse. Alternative 1 would not result in impairment.	control agents administered by hand to test subjects. Restored habitats would benefit wildlife species, with the magnitude of the benefits being negligible for bighorn sheep, mountain lion, and bobcat; negligible to minor for black bear; minor for moose, red fox, scavengers, small mammals, raptors, upland shrub birds, and fish; minor to moderate for ptarmigan, waterfowl and shorebirds, and amphibians and reptiles; moderate for beaver and butterflies; and moderate to major for songbirds and cavity nesters. There would be no net effect on coyotes and impacts on red foxes would be adverse and negligible. Cumulative effects of other plans, projects, and actions combined with the effects of Alternative 2 would be long-term, moderate, and adverse. Alternative 2 would not result in impairment.			
Water Resources	Hydrological changes as a result of a reduced beaver population in the park would continue to represent	Recolonization or reintroduction of beaver would cause long term, local, moderate, beneficial effects	Recolonization or reintroduction of beavers would result in long term, local, moderate, beneficial	Recolonization or reintroduction of beavers would result in overall effects on hydrology similar	Recolonization or reintroduction of beavers would result in overall effects on hydrology similar

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Water Resources (continued)	a long-term, local, major, adverse effect on hydrology and stream structure in the winter elk range. Effects would be moderate, but progress to major later in the plan in the summer elk range. Sediment entering streams from erosion of bare ground would be long term, local, minor, and adverse in the winter elk range and Kawuneeche Valley, but negligible in other areas of the primary summer range. Bank destabilization would cause a slight increase in turbidity, resulting in long-term, local, negligible-to-minor, adverse effects on water quality in the core winter range and Kawuneeche Valley and negligible adverse effects on water quality in the remainder of the winter and summer elk range. Slight increases in water temperature during the summer months would represent a long-term, local, negligible, adverse effect on water quality. Effects on water quality from elk introducing bacteria,	on hydrology in the elk core winter range and possibly Kawuneeche Valley and minor benefits in other portions of the primary winter range and the primary summer range. Increased willow cover with decreased erosion and turbidity would result in a long-term, local, negligible, beneficial impact on water quality. Short-term adverse impacts from lethal control and vegetation management activities would be local and negligible to minor with mitigation measures. Increased stream shading would produce a long-term, local, negligible, beneficial effect on water temperature. Slightly less contamination from the introduction of bacteria, ammonia, nitrates, and fecal matter by elk would result in a local, negligible, beneficial effect. Prescribed burns could potentially alter stream chemistry in the short term, a local, minor, adverse effect. Cumulative effects on hydrology and stream structure would be long term, minor to moderate, and	effects on hydrology, although changes in hydrology would vary between fenced and unfenced areas. Cumulative effects on hydrology and stream structure would be long term, minor to moderate, and beneficial. Cumulative effects on water quality would be negligible and adverse. Alternative 3 would not result in impairment.	to those described for Alternative 3. No effect on water quality would occur from the use of fertility control agents. Cumulative effects on hydrology and stream structure would be long term, minor to moderate,and beneficial. Cumulative effects on water quality would be negligible and adverse. Alternative 4 would not result in impairment.	to Alternative 2. The release of wolves would have no effect on water quality. Cumulative effects on hydrology and stream structure would be long term, minor to moderate, and beneficial. Cumulative effects on water quality would result in no effect. Alternative 5 would not result in impairment.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Water Resources (continued)	ammonia, nitrates, and fecal matter to surface waters would be long term, negligible, and adverse. Cumulative effects on hydrology would be long term, major, and adverse. Cumulative effects on water quality would be long term, moderate, and adverse. Alternative 1 would not result in impairment.	beneficial. There would be no cumulative effects on water quality. Alternative 2 would not result in impairment.			
Soils and Nutrient Cycling	The adverse effects on soils from compaction and bare ground would be long term, local, and minor in the core winter range but negligible elsewhere in the elk range. Effects from erosion on soils would be long term, local, negligible to minor, and adverse. Increased bank instability from reduced willow cover would result in a long-term, local, negligible, adverse effect. In upland shrub areas, a 30% decrease in calcium, magnesium, and other cations would continue to result in a long-term, local, minor-to-moderate, adverse impact on soils in the primary winter range but	Reduced bare ground and compaction and, therefore, erosion would result in a long-term, local, minor, beneficial effect on soils. Improved bank stabilization would be a long term, local, negligible, beneficial effect. Short-term effects of management activities would be local, minor, and adverse to soils, except for mechanical thinning and prescribed burning, which would have local, minor-to-moderate, adverse effects. Effects on nutrient cycling aspects of soils in willow and aspen areas would be long term, local, minor, and beneficial. Increases in nitrogen inputs would be a	Reduced bare ground, compaction, and erosion would result in a long-term, local, minor benefit on fenced soils and a local, negligible, beneficial effect on unfenced soils. Short-term effects from management activities would result in minor, local, adverse impacts, except for mechanical thinning and burning, which would be minor to moderate. Improved bank stabilization would be a long-term, local, negligible benefit. Impacts on nutrient cycling would be similar to those described under Alternative 2, although effects would be incrementally greater in	Reduced bare ground, compaction, and erosion would result in a long-term, local, minor benefit to fenced soils in the winter elk range and a local, negligible, beneficial effect on unfenced soils in the primary winter and summer elk range. Short-term effects from the plan's activities would result in minor, local, adverse impacts on the winter and summer elk ranges, except for mechanical thinning and burning, which would be minor to moderate. Improved bank stabilization would be a long term, local, negligible benefit. Impacts on nutrient cycling	Effects from elk population reduction on bare ground, compaction, and erosion would be similar to those described for Alternative 2. Impacts on nutrient cycling for aspen and willow would be similar to those described under Alternative 2. Increases in cations and phosphorus on upland shrub areas from a reduction in elk would be the same as described for Alternative 2. Effects from mechanical thinning and burning on nutrient cycling would be the same as described for Alternative 2. Effects on mycorrhizae would be the same as described for Alternative 2. The release

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Soils and Nutrient Cycling (continued)	minor in the primary summer range. Reduction in available soil nitrogen and carbon over time in aspen and willow communities would be a long-term, local, minor, adverse effect. A reduction in overall pools and fluxes of nitrogen and carbon in short willow and aspen areas would be a long-term, local, moderate, adverse effect. Increases in nitrogen inputs to mixed conifer habitats would have long-term, local, minor, adverse effects on the elk core winter range but negligible-to-minor effects in other portions of the elk range. Continued reduction in mycorrhizal levels and changed species composition would result in a long-term, minor, adverse effect on soils in the core winter range and a negligible adverse effect on the remainder of the elk range. The continued lack of flooding from a reduced beaver population represents a long-term, local, minor, adverse effect on soils.	long-term, local, moderate benefit in the elk core winter range, and minor benefits would occur locally on the remainder of the primary winter range and the primary summer range. Increases in cation availability would result in a minor, beneficial effect on upland shrub area soils. Mechanical thinning of willow and aspen sites would increase nitrogen mineralization and nitrification, a local, long-term, minor, beneficial effect. Prescribed burns would result in long-term, minor benefits and short-term, local, minor, adverse effects. Willow replantings would slightly increase nitrogen and carbon pools, a local, negligible beneficial effect. Upland shrub area soils would experience local, minor benefits. Increased mycorrhizal levels in the soil would produce a long-term, local, minor, beneficial effect. Increases in the water table associated with increases in beaver would	fenced areas. Increases in cations and phosphorus on upland shrub areas would be the same as described for Alternative 2. Effects on soils from changes in nutrient cycling from mechanical thinning activities would be the same as described for Alternative 2. Effects from prescribed burns would be the same as described for Alternative 2. Effects from willow replantings would be the same as described for Alternative 2. Effects on mycorrhizae would be the same as described for Alternative 2. Overall benefits from increased flooding of soils would be long term, local, and minor. Cumulative effects on bare ground, compaction, erosion, and flooding of soils would be long term, minor to moderate, and beneficial. Cumulative effects on nutrient cycling would be long term, minor, and adverse.	would be similar to those described under Alternative 2, although effects would be incrementally greater in fenced areas. Increases in cations and phosphorus on upland shrub areas from a reduction in elk would be the same as described for Alternative 2. Effects on soils from changes in nutrient cycling from mechanical thinning activities would be the same as described for Alternative 2. Effects from prescribed burns would be the same as described for Alternative 2. Effects from willow replantings would be the same as described for Alternative 2. Effects on mycorrhizae would be the same as described for Alternative 2. Overall benefits from increased flooding of soils would be long term, local, and minor. Cumulative effects on bare ground, compaction, erosion, and flooding on soils would be long term, minor to moderate, and beneficial. Cumulative effects on cycling on soils	of wolves would likely directly contribute negligible, beneficial effects on nutrient cycling and soil productivity. Effects from increased microbial activity from flooding of soils would be similar to those described for Alternative 2. Cumulative effects on bare ground, compaction, erosion, and flooding of soils would be long term, minor to moderate, and beneficial. Cumulative effects on nutrient cycling would be long term, minor, and adverse. Alternative 5 would not result in impairment.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Soils and Nutrient Cycling (continued)	Cumulative effects on bare ground, compaction, erosion, and flooding of soils would be long term, minor, and beneficial. Cumulative effects on nutrient cycling would be long term, moderate, and adverse. Alternative 1 would not result in impairment.	represent a long-term, local, moderate, beneficial effect. Cumulative effects on bare ground, compaction, erosion, and flooding of soils would be long term, minor, and beneficial. Cumulative effects on nutrient cycling would be long term, minor, and adverse. Alternative 2 would not result in impairment.	Alternative 3 would not result in impairment.	would be long term, minor, and adverse. Alternative 4 would not result in impairment.	
Natural Soundscape	Maintenance of research plot fencing would have a negligible, adverse effect on soundscapes. Effects of redistribution techniques on soundscapes would continue to be short-term, local, negligible, and adverse. Short-term effects that would continue to periodically occur for management actions would continue to be local, negligible, and adverse. Monitoring would continue to result in short-term, negligible-to-major, adverse effects. Cumulative effects of other plans and projects and the actions of Alternative 1 would continue to be short-	Lethal removal of elk using noise-suppressed weapons would result in short-term, local, minor, adverse effects. Unsuppressed weapons would have short-term, local, negligible-to-major adverse effects on undeveloped areas and short-term, local, minor adverse effects on developed areas. Effects of darting associated with lethal reduction or research activities would be short-term, local, and negligible to minor for developed and negligible to moderate for undeveloped areas. Removal of carcasses would result in short-term, negligible, adverse effects in developed areas and	Effects from lethal removal using subsonic noise-suppressed weapons would have the same effect as described for Alternative 2. Unsuppressed weapons would have short-term, local, negligible to major effects in undeveloped, and short-term, local, minor, adverse effects in developed areas. Darting associated with lethal reduction or research activities would have the same effect as under Alternative 2. Removal of carcasses would have the same effects as described for Alternative 2. Fencing under Alternative 3 would be more extensive than under Alternative 2 but	Effects from lethal removal using both noise-suppressed and unsuppressed weapons would be the same as described for Alternative 3. Effects of darting associated with lethal reduction or research activities would be the same as described for Alternative 2. Removal of carcasses would have the same effects as described for Alternative 2. With fertility control, dart gun use, human activity, and annual treatments would result in short-term, local, and negligible to moderate effects.	The initial release process would have a short-term, local, negligible, adverse effect on soundscapes. Were wolves to be adversely conditioned or lethally removed, effects on soundscape would be short-term, local, negligible to moderate, and adverse. Effects of wolves' howling on the park's soundscape could vary from minor to moderate and would be short-term, parkwide, and beneficial; and would occur at least for the length of the plan. Wolf monitoring and recapture efforts would result in a short-term, major, adverse effect on soundscapes if helicopters

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Natural Soundscape (continued)	term, local and regional, minor-to-major, and adverse. Alternative 1 would not result in impairment.	negligible to minor, adverse in undeveloped areas. If helicopters were used to remove carcasses from remote areas, effects on soundscapes would be short-term, negligible-to-major, and adverse. Erecting a capture facility would have short-term, local, minor adverse effects on soundscapes. Vehicles accessing the capture facility would have short-term, local, minor, adverse effects on soundscapes in developed and undeveloped areas. Effects from fencing installation would be short-term, local, minor, and adverse in undeveloped areas and short-term, local, negligible, and adverse in developed areas. If helicopters were used, effects would increase to short-term, negligible-to-major, and adverse. Effects on the soundscape from prescribed burns would be minor to major, short-term, local, and adverse. Mechanical thinning activities would result in short-term, local, moderate,	overall effects would be the same. Effects on soundscapes from prescribed fire would be the same as described for Alternative 2. Redistribution techniques under Alternative 3 would have the same intensity as under Alternative 2. Effects of herding on soundscapes would be the same as described in Alternative 2. Effects of actions towards aggressive or injured animals would be the same as described for Alternatives 1 and 2. Effects of monitoring would be the same as described for Alternatives 1 and 2. Cumulative effects would be similar to those described for Alternative 2. Alternative 3 would not result in impairment.	Erecting and using a temporary capture facility would have the same effects as described for Alternative 2 Redistribution techniques would have the same intensity level as Alternative 3. Effects of herding on soundscapes would be the same as in Alternative 2. Effects from fencing would be the same as described for Alternative 3. Effects from prescribed fire and mechanical thinning would be the same as described for Alternative 2. Effects of actions towards aggressive or injured animals would be the same as described for Alternatives 1 and 2. Effects of monitoring would be the same as described for Alternative 2. Cumulative effects would be similar to those described for Alternative 2. Alternative 4 would not result in impairment.	were used. Effects of lethal removal using both noise-suppressed and unsuppressed weapons would be the same as described for Alternative 2. Effects of darting activities would be the same as described for Alternative 3. Removal of carcasses would have the same effects as described for Alternative 2. Erecting and using a temporary capture facility would have the same effects as described for herding on soundscapes would be the same as in Alternative 2.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Natural Soundscape (continued)		adverse effects. Effects from redistribution techniques would be short-term, local, moderate, and adverse in undeveloped areas and short-term, local, minor, and adverse in developed areas. Herding would have short-term and long-term, local, negligible to major, adverse impacts. Effects on soundscapes from actions to manage aggressive or injured animals would be the same as described for Alternative 1. Effects from monitoring would be the same as for Alternative 1. Cumulative effects would be similar to those described for Alternative 1. Alternative 2 would not result in impairment.			Effects on soundscapes from fencing would be the same as described for Alternative 3. Effects on soundscape from prescribed fire and mechanical thinning would be the same as described for Alternative 2. Effects of actions towards aggressive or injured animals would be the same as described for Alternatives 1 and 2. Effects of monitoring would be the same as described for Alternative 2. Cumulative effects would be similar to those described for Alternative 1. Alternative 5 would not result in impairment.
Wilderness	Noticeable levels of vegetation degradation in willow and aspen communities would continue to have a long-term, local, moderate, adverse effect on wilderness. Limited fencing activities	Recovery of vegetation in localized area would result in a long-term, moderate, benefit to wilderness, representing more natural conditions. Lethally removing elk using noise-suppressed and unsuppressed weapons result	Effects from the reduction of elk, addition of fencing, prescribed fires, and mechanical thinning on natural conditions would be the same as described for Alternative 2. Lethally removing elk using noise-suppressed and	More natural conditions for vegetation and ecosystems would be a long-term, range-wide, moderate, benefit to wilderness. Fencing, prescribed fires, and mechanical thinning would have long-term, range-wide, moderate,	Recovery of willow and aspen vegetation in localized areas would result in a long-term, moderate, benefit. Effects of releasing wolves in wilderness would be long term, park wide, and major beneficial. The process of releasing wolves

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Wilderness (continued)	would result in local, negligible, adverse effects. Minimal redistribution technique use in wilderness would result in short-term, local, minor, adverse effects. Removing animals suspected of having chronic wasting disease would have a short-term, local, minor, adverse effect. Monitoring of elk and vegetation would have a short-term, regional, negligible-to-major, adverse effect. Cumulative effects on wilderness would be long-term, minor to moderate, and adverse as well as short-term, minor to moderate, and adverse. Alternative 1 would not result in impairment.	in short term, local, negligible-to-major, adverse effects, depending on the distance from the noise source. Darting associated with lethal reduction or research would result in local, minor, adverse effects. Carcass removal would result in short term, local, minor, adverse effects. Erecting a temporary capture facility associated with lethal reduction would be a short-term, local, moderate, adverse effect. Effects of accessing wilderness would be short-term, local, minor to moderate, and adverse. Effects on wilderness from installing fencing and the presence of fences around aspen would be long term, local, moderate, and adverse. Prescribed fires would have short-term, local, moderate, adverse effects; mechanical thinning would have short-term, local, moderate, adverse effects. Fire would restore a natural process into wilderness areas that would result in a long-term, moderate, local beneficial	would be short term, local, unsuppressed weapons would have the same effects as in Alternative 2. Effects from darting associated with lethal reduction or research would be the same as in Alternative 2. Carcass removal would have the same effects as described for Alternative 2. Effects of accessing the wilderness would be short-term, local, minor to moderate, and adverse. Effects on wilderness from installing fencing and the presence of fences around aspen and willow would be long term, local, major, and adverse. Prescribed fires would have the same effects as described for Alternative 2, as would restoring natural processes into wilderness areas and mechanical thinning. Use of helicopters would have effects as described for Alternative 2. Monitoring would have short term, regional, moderate, and adverse effects. Effects of	beneficial effects on wilderness. Lethally removing elk using noise-suppressed and unsuppressed weapons would result in short-term, local, negligible-to-major, adverse effects. Effects on wilderness from darting associated with lethal reduction or research would be the same as in Alternative 2. Carcass removal would have the same effects on wilderness as described for Alternative 2. Erecting a temporary capture facility would have the same effects on wilderness as described for Alternative 2. Effects from installing fencing and the presence of fences around aspen and willow would be long term, local, major, and adverse. Use of helicopters would have the same effects as described for Alternative 2. Prescribed fires would have the same effects as described for Alternative 2, as would restoring natural	would have short term, local, minor, adverse effects on wilderness. Lethally removing elk using noise-suppressed and unsuppressed weapons would have the same effects as in Alternative 2. Effects from darting associated with lethal reduction or research would be the same as in Alternative 2. Carcass removal would have the same effects as described for Alternative 2. Effects of accessing the wilderness would be short-term, local, minor to moderate, and adverse. Erecting a temporary capture facility associated with lethal reduction would have the same effects as described for Alternative 2. Effects on wilderness from installing fences and the presence of fences around aspen would be the same as described for Alternative 2. Use of helicopters would have the same effects as described for Alternative 2. Prescribed fires would have the same effects as for

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Wilderness (continued)		effect in areas treated. Tagging or marking study elk and fertility control agents' disruption of natural biological processes for treated elk would result in short-term, range-wide, minor, adverse effects. Use of helicopters would have short-term, range-wide to regional, negligible-to-major, adverse effects. Effects of redistribution techniques would be short term, local, minor, and adverse. Herding would result in short-term, local, adverse effects that would vary from minor to moderate. Removing animals suspected of having chronic wasting disease would have the same effects as for Alternative 1. Monitoring would have short term, regional, moderate, and adverse effects. Recovery of willow and aspen within wilderness would be a long-term, moderate benefit. Cumulative effects on wilderness would be long term, minor to moderate, and adverse as well as short term,	redistribution techniques minor, and adverse. Herding would have the same effects as described for Alternative 2. Tagging or marking study elk and fertility control agents' disruption of natural biological processes for treated elk would result in short-term, range-wide, minor, adverse effects. Removing animals suspected of having chronic wasting disease would have the same effects as for Alternative 1. Monitoring would have the same effects as for Alternative 1. Cumulative effects on wilderness would be long term, minor to moderate, and adverse as well as short term, moderate to major, and adverse. Alternative 3 would not result in impairment.	processes into wilderness areas and mechanical thinning. Effects of redistribution techniques would be similar to Alternative 2. Herding would have the same effects as described for Alternative 2. Removing animals suspected of having chronic wasting disease would have the same effect as for Alternative 1. Monitoring would have the same effects as for Alternative 1: short term, regional, moderate, and adverse. Effects of accessing the wilderness would be short-term, local, minor to moderate, and adverse. Fertility control and research activities would have short-term, local, minor, adverse effects. The tagging of treated elk and disruption of natural biological processes would have long-term, range wide, minor, and adverse effects. Cumulative effects on wilderness would be long term, minor to moderate,	Alternative 2, as would restoring natural processes into wilderness areas and mechanical thinning. . Tagging or marking study elk and fertility control agents' disruption of natural biological processes for treated elk would result in short-term, range-wide, minor, adverse effects. Effects of redistribution techniques would be similar to Alternative 2. Herding would have the same effects as described for Alternative 2. Effects of removing animals suspected of having chronic wasting disease would be short term, local, negligible-to-minor, and adverse. Monitoring would have the same effects as for Alternative 1. Effects from the reduction of elk, addition of fencing, prescribed fires, and mechanical thinning on natural conditions would be the same as described for Alternative 2. Cumulative effects on wilderness would be long

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Wilderness (continued)		moderate, and adverse. Alternative 2 would not result in impairment.		and adverse as well as short term, moderate to major, and adverse. Alternative 4 would not result in impairment.	term, minor to moderate, and adverse as well as short-term, moderate, and adverse. Alternative 5 would not result in impairment.
Socioeconomics	No change in visitation attributable to the elk would be expected, resulting in continued moderate-to-major, long-term, beneficial impact in the region. Alternative 1 would continue to contribute a long-term, moderate, beneficial impact from its contribution to hunting. Revenues related to elk would continue to be a moderate, long-term benefit to Rocky Mountain National Park, and elk-related costs would be long-term, minor, and adverse. The Town of Estes Park would continue to receive long-term, moderate benefits from elk-related revenues and negligible, adverse effects from costs. The Estes Valley Recreation and Park District would receive negligible benefits from elk-related revenues, but would continue to experience long-	Alternative 2 would be expected to create a net short-term, minor-to-moderate, adverse effect on tourism and recreation draw, but a negligible, long-term effect on visitation. There would be a net negligible-to-minor, adverse, long-term impact on hunting. There would be no effect on visitation to the park or region or on hunting as a result of short-term research activities on a multi-year fertility control agent and chronic wasting disease live testing. Rocky Mountain National Park, Estes Park, and the Estes Valley Recreation and Park District would experience short-term loss of revenue, but long-term fiscal impacts would be negligible for all government entities. In the short and long term, there would be a minor-to-	Alternative 3 would be expected to create a net short-term, minor to moderate adverse effect on tourism and recreation draw, but a negligible long-term effect on visitation. In the short-term, visitation would decrease, but long-term visitation would not be affected. The National Park Service, Estes Park and the Estes Valley Recreation and Park District would experience a short-term loss of revenue, but long-term fiscal impacts would be negligible for all government entities. There would be no effect on visitation or hunting as a result of short-term research activities on a multi-year fertility control agent and chronic wasting disease live testing. In the short and long-term, there would be a minor to moderate benefit to	A drop in visitation due to large-scale fertility control for population management, lethal reduction, and fencing, with losses of $3 million in sales, $1 million in personal income, and 75 jobs would have a moderate, adverse impact in the long term. There would be no effect on visitation to the park or region as a result of short-term research activities on chronic wasting disease live testing. A drop in hunter activity and direct economic contribution from hunters near the east and west sides of the park would result in a minor-to-moderate, adverse, short- and long-term, impact would result due to use of fertility control agents on a large-scale for population control. The effects to hunting as a result of research activities involving	Potential for a 10% gain in visitors, an additional $3 million in sales, $1 million in personal income, and 75 new jobs within the park and the surrounding area would be a net moderate beneficial impact on park visitation and tourism in the Estes Valley. Short term, there would be a net negligible to minor impact on hunting activity as a result of this alternative. There would be a net negligible-to-minor, adverse, long-term impact. There would be no effect on visitation or hunting as a result of short-term research activities on multi-year fertility control agent and chronic wasting disease live testing. The park would probably see a moderate-to-major, long-term increase in annual entrance fee revenue and a moderate, short- and long-

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Socioeconomics (continued)	term, moderate, adverse effects from costs. The overall impacts on the Colorado Division of Wildlife would continue to be negligible to minor and adverse. There would be a continued long-term, minor-to-moderate, adverse impact on landscaping and private property. There would continue to be a moderate, long-term, adverse impact on the ranching and agricultural community. Elk would continue to make a minor-to-moderate, seasonal contribution to congestion and traffic accidents in the park and Estes Park. This alternative would have a minor to moderate beneficial, long-term effect on body shops. Elk would continue to contribute a net minor-to-moderate benefit to the quality of life of Estes Valley residents. Property values would experience a negligible, long-term impact.	moderate benefit to homeowners and loss to landscaping companies. Agriculture would experience minor-to-moderate, short- and long-term benefits. Traffic congestion would decrease in the short-term, but there would be minor, long-term, beneficial impacts. Elk-related traffic accidents would decrease in the short and long term, and beneficial impacts would be negligible to minor. There would be a minor, short- and long-term adverse impact on Estes Park body shops. There would be minor, short- and long-term benefits to property values. The moderate to major cumulative benefits within the Estes Valley socioeconomic environment would continue under Alternative 2. The minor to moderate adverse cumulative effects within the Estes Valley socioeconomic environment would continue under Alternative 3.	homeowners and loss to landscaping companies from a decrease in elk-related damage. Agriculture would experience minor-to-moderate, short- and long-term benefits. Traffic congestion would decrease in the short-term, but there would be minor, long-term beneficial impacts. Elk-related traffic accidents would decrease in the short and long-term, and beneficial impacts would be negligible to minor. There would be a minor short and long-term adverse impact on Estes Park body shops. Impacts on hunting activity and experience would be the same as under Alternative 2. The impacts on property values would be the same as under Alternative 2. The moderate to major cumulative benefits within the Estes Valley socioeconomic environment would continue under Alternative 3. The minor to moderate adverse cumulative effects within the Estes	immobilization drugs and fertility control agents would not be distinguishable from the effects of the large-scale treatment of the population. Net impacts on the public sector would be minor to moderate and adverse in the long term due to the decrease in visitors. Traffic congestion would decrease in the short-term, but there would be minor, long-term beneficial impacts. Elk-related traffic accidents would decrease in the short and long-term, and beneficial impacts would be negligible to minor. There would be a minor short and long-term adverse impact on Estes Park body shops. This alternative would result in a net negligible, long-term, adverse impact on property values. The minor-to-moderate, adverse, cumulative effects within the Estes Valley socioeconomic environment would continue under Alternative 4.	term increase in costs. The Town of Estes Park would experience a moderate-to-major, long-term increase in revenue. The Estes Valley Recreation and Park District would experience a negligible to minor net effect due to decreased elk near the east side of the park and increased visitors. Wolves would have a moderate-to-major negative impact on CDOW costs. Local homeowners would likely see a minor, short- and long-term decrease in landscaping costs. The net short- and long-term impact, taking into account the benefit to homeowners and the loss to landscaping companies, would be negligible. There would be short- and long-term, minor, adverse impact as a result of potential wolf depredation on pets. There would be a net minor-to-moderate, short- and long-term benefit to agriculture. There would be a minor short- and long-term, adverse impact on Estes Park body shops and a

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Socioeconomics (continued)	Cumulative benefits within the socioeconomic environment would continue to be long-term and moderate to major. Cumulative adverse effects would continue to be long term and minor to moderate.		Valley socioeconomic environment would continue under Alternative 3.		minor short- and long-term, beneficial impact from reduced accidents. There would be a net, minor, long-term, beneficial impact on property values. The minor to moderate adverse cumulative effects within the Estes Valley socioeconomic environment would continue under Alternative 5.
Public Health and Safety	Impacts on safety over the long term resulting from visitors' efforts to view or photograph elk are negligible and adverse. This could increase the intensity of long-term, adverse risks from negligible to minor with increased visitation. The impact of elk control activities on staff and volunteer safety is long term, negligible to minor, and adverse. The possibility of chronic wasting disease transmission to humans from handling elk under Alternative 1 would remain long term, negligible, and adverse. The use of firearms and dart rifles for	Lethal control activities would result in long-term, adverse impacts on employee health and safety at a negligible-to-minor intensity. Reduced elk numbers, concentrations, and habituation in combination with redistribution activities would result in a long-term, negligible-to-minor, beneficial impact on health and safety. Use of darts and handling of drugged animals for lethal reduction or research activities would have short- and long-term, adverse impacts on health and safety that would be mitigated by adherence to NPS policy and protocol *to* a negligible to minor level.	Reduced elk numbers, concentrations, and habituation to humans in combination with aversive conditioning activities would result in a long-term, negligible-to-minor, beneficial impact. Use of darts and handling of drugged animals for lethal reduction or research activities would have short- and long-term, adverse impacts on health and safety that would be mitigated by adherence to NPS policy, guidance, and protocol to a negligible to minor level. Adverse impacts from handling elk carcasses and live elk to be tested for chronic wasting disease would be negligible.	The risk posed by the elk population and management and reduction activities would be similar to Alternative 3. Risks associated with the use of darts and handling drugged animals for population management or research activities would have long-term, adverse impacts on health and safety, mitigated to a negligible to minor level. With observing standard precautions, risks of consuming meat from treated elk would be reduced, the long-term, adverse impacts on health and safety to a negligible level.	Lethal control and research activities would result in long-term, adverse impacts on employee health and safety at a negligible to minor intensity. Reduced elk numbers, concentrations, and habituation in combination with aversive conditioning activities would result in a long-term, negligible to minor, beneficial impact on health and safety. Adverse impacts of using a capture facilities for lethal reduction would be short term and negligible to minor. Herding or bait lines to get elk to the facility would result in long-term, negligible-to-minor, adverse impacts.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Public Health and Safety (continued)	lethal control of elk infected with chronic wasting disease results in long-term, negligible-to-minor, adverse impacts for staff or contractors. The long-term, adverse impacts on public health and safety of vegetation management, including fencing, under Alternative 1 are negligible. Cumulative impacts would continue to be minor to moderate and beneficial.	Adverse impacts of capture facilities for lethal reduction on health and safety would be short- term and negligible to minor. Herding or bait lines to get elk to the facility would result in long-term, negligible-to-minor, adverse impacts. Carcass handling would result in long-term, negligible, adverse impacts. Effects on public health and safety from activities associated with fencing would be short-term, negligible, and adverse. Effects on public health and safety from thinning or prescribed burns would be short-term or long-term, minor, and adverse. Adverse impacts on public health and safety due to smoke would be short term and negligible. Cumulative impacts would continue to be minor to moderate and beneficial.	Staff training and limited area closures during more frequent redistribution actions would keep associated short-term, adverse impacts to a negligible-to-minor level. Impacts of human-elk interactions outside the park on public health and safety would be long term, negligible, and beneficial. The effects on public health and safety from activities associated with fencing would still be short-term, negligible, and adverse. The effects of prescribed burning and mechanical thinning would be the same asunder Alternative 2. Cumulative impacts would continue to be minor to moderate and beneficial.	The effects on human health and safety from fencing and prescribed burning would be the same as under Alternative 3. Adverse impacts on public health and safety due to smoke would be short term and negligible. Cumulative impacts would continue to be minor to moderate and beneficial.	Adverse impacts associated with wolf release activities and monitoring and tracking wolves after release would be minor. With wolf management and public education, long-term, adverse impacts on health and safety would be negligible. Long- and short-term adverse impacts from elk seeking refuge would be negligible-to-minor in campgrounds, visitor centers, and other areas with high concentrations of people. The impact of human-elk interactions outside of the park would be negligible. The effects from fencing and prescribed burning would be the same as under Alternative 3. Adverse impacts on public health and safety due to smoke would be short term and negligible. Cumulative impacts would continue to be minor to moderate and beneficial.

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Visitor Use and Experience	Opportunities to view elk would continue to provide a moderate-to-major benefit over the long term. High concentrations of visitors viewing elk would cause moderate-to-major, adverse impacts over the long term for visitor preferring less crowding; minor-to-moderate for others. Visitors who prefer to view the park's wildlife under more natural conditions would experience negligible-to-moderate, long-term, adverse impacts. Impacts on aspen and willows from elk over-browsing would continue to cause minor-to-major, long-term, adverse effects on visitors who are aware of the conditions; for the overall visitor population, the effect would be minor and adverse. Experimental fencing to protect selected aspen communities would result in a negligible, long-term, adverse impact on visitors' experiences. The use of helicopters would result in negligible-to-major, short-term, adverse impacts.	The adverse impacts on visitors who visit the park with an interest in viewing elk would be negligible to minor over the long term. Impacts on visitor experience from crowding would be negligible, long term, and beneficial. The net effect for those who prefer to view elk and other wildlife in a relatively natural setting would be minor, long term, and beneficial; for most visitors, the beneficial impact would be negligible to minor. The return of plant communities would result in a minor, long-term benefit. Adverse impacts lethal control activities would be short term and moderate in the first four years reduced to minor in the remaining 16 years of the plan.	Adverse impacts of small-scale, lethal control using firearms would be short term and minor to moderate. Use of firearms with noise suppression and subsonic ammunition at night would reduce adverse impacts on visitor use and experience to minor. Effects on visitors due to management of the elk population would be similar to those of Alternative 2, including impacts on visitor experience from crowding, viewing opportunities for other wildlife and opportunities to view wildlife in a relatively natural setting, and the return of plant communities. The effects of lethal reduction activities on visitors' experience would be similar to those under the last 16 years of Alternative 2, short-term, adverse and minor. The effects of firearms use to dart elk and handling of elk for research activities would be the same as for lethal reduction activities. Marking of elk and treatment with fertility control agents for	Visitor opportunities to view elk and the impact on visitors' experience, including crowding, would be the same as under Alternative 3: negligible to minor over the long-term. Viewing opportunities for other wildlife and opportunities to view wildlife in a relatively natural setting would be similar to opportunities under Alternative 2: negligible to minor, long term, and beneficial. The return of plant communities and the benefits to visitors' experience would be similar to Alternative 2: negligible-to-minor, long-term, and beneficial. Elk treated with a fertility control agent for population management and research activities would receive a short-term mark, such as from a paintball, to prevent multiple treatments, and possible markings to warn hunters against consumption. Hunters could experience minor, adverse impacts over the long term from such warnings. Human-made	Visitor opportunities to view elk would be the same as under Alternative 3 in the early years of the plan and for crowding, such as at somewhat greater in the later years. Dispersal of elk by wolves would be greater and viewing opportunities in large meadows would increase, resulting in a minor, long-term benefit. There would be an overall negligible-to-minor, long-term, beneficial impact due to improved natural settings from wolves' overall impacts on other wildlife, but a negligible to minor, adverse impact on the ability of visitors to view certain species affected by wolves. For the visitors who value wolves or a more complete ecosystem, the opportunity to see or hear wolves would provide a long-term, minor-to-moderate benefit. For visitors who fear wolves and would choose not to hike or backpack as a result of wolf presence would experience a long-term, minor to moderate adverse impact. Increased visitation and

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Visitor Use and Experience (continued)	Cumulative benefits would be long-term and moderate.	The effects of firearms use to dart elk and handling of elk for research activities would be the same as for lethal reduction activities. Marking of elk for research purposes would have short-term, minor, adverse effects. Seeing a capture facility could have minor adverse effect on some visitors. The adverse impacts on visitors as a result of closures during lethal elk reduction activities would be negligible to minor and short term. Aerial activity associated with monitoring, management of elk, or fence installation would produce negligible-to-major, short-term, adverse impacts on visitors' experience. Fencing would cause a long-term, local, minor-to-major, adverse impact. The use of prescribed burns to stimulate growth of aspen and willows -would cause negligible-to minor, adverse impacts over the long term. Cumulative impacts would continue to be moderate, long-term, and beneficial.	research purposes would have short-term, minor, adverse effects. The effects of area closures would be similar to the last 16 years of Alternative 2. Aerial activity associated with monitoring or management of elk would be similar to Alternative 2. Fence to protect aspen and montane riparian willow would result in major adverse impacts. The effects of prescribed fire would be the same as under Alternative 2. The cumulative impact would continue to be moderate, long-term, and beneficial.	marks or collars would diminish the viewing experience, and visitors would experience short-term, minor, adverse effects over the long term. Adverse impacts associated with fences would be the same as under Alternative 3: long-term, major, and adverse. The effects of prescribed fire would be the same as under Alternative 2: long-term, negligible to minor, and adverse. The effects of firearms use to dart elk and handling of elk for research activities would be the same as for lethal reduction activities. Marking of elk and treatment with fertility control agents for research purposes would have short-term, minor, adverse effects. Overall, the cumulative impact on visitor use and experience from conditions within the park would continue to be moderate, long-term, and beneficial.	increased opportunities wolf sightings, would result in long-term, minor, adverse impacts on visitor experience. The return of plant communities and the benefits to visitors' experience would be similar to Alternative 2. If emphasis must be placed on lethal reduction over the actions of wolves, the effects on visitor experience would be as similar to those under Alternative 2. If wolves are effective in reducing elk numbers and distributing elk, there would be minor to moderate, long-term, positive impacts on those who perceive wolves to be an ethical and natural method for reducing elk populations and controlling their movements. The impacts associated with an elk capture facility plus holding pens that would be used for the release of wolves would produce

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Visitor Use and Experience (continued)					impacts similar to Alternative 2. If area closures would be more intense in the first four years, impacts would be similar to Alternative 2. Aerial activity associated with monitoring or management of elk would be similar to Alternative 2. The effects of aspen fencing would be similar to those under Alternative 2. The effects of prescribed fire would be the same as under Alternative 2. The effects of firearms use to dart elk and handling of elk for research activities would be the same as for lethal reduction activities. Marking of elk for research purposes would have short-term, minor, adverse effects. The cumulative impacts would continue to be moderate, long-term, and beneficial.
Park Operations	The ongoing monitoring and management activities throughout the park would create long-term, negligible, adverse effects. Park staff would continue to update media regularly with the	The logistical and operational changes involved in the lethal reduction would result in short-term, minor-to-moderate, adverse impacts for the first four years, declining to short-term and	The operational changes involved in the lethal reduction would result in short-term, minor-to-moderate, adverse effects for the life of the plan. The beneficial effects of reduced	Lethal reduction and fertility control activities and the removal of carcasses would result in long-term, minor-to-moderate, adverse effects on park operations. The labor involved in the	The release and monitoring of wolves would result in short-term, negligible-to-minor, adverse effects on park operations. Lethal reduction activities would result in minor-to-moderate,

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Park Operations (continued)	condition of the elk population and its habitat, and no measurable change would occur in the management of volunteers, resulting in long-term, negligible, adverse effects on park operations. Cumulative effects would be long-term, minor-to-moderate, and adverse.	minor for the remainder of the plan. Tasks related to the capture facility would result in short-term, negligible-to-minor, adverse impacts on park operations. The decreased need for managing elk/human conflicts would result in short- and long-term, minor, beneficial effects. During lethal reduction activities, increased visitor control would result in short-term, negligible-to-minor, adverse effects. Fence installation would result in short- and long-term, negligible, adverse effects on park operations. The tasks and allocation of resources related to continued monitoring activities would create long-term, minor-to-moderate, adverse effects. Redistribution techniques would have a long-term, minor-to-moderate, adverse effect. Increased prescribed burning would have short-term, minor, adverse effects. The initial development of new interpretive and educational media would result in a short-term, minor-to- moderate, adverse effect	elk-human conflicts would be short- and long-term and of minor intensity. During lethal reduction activities, the increased need for visitor control would result in short-term, negligible to minor, adverse effects. The increased installation and maintenance of fences would result in short- and long-term, minor-to-moderate, adverse effects. Monitoring activities would create long-term, minor-to-moderate, adverse effects. Elk redistribution would result in long-term, moderate, adverse effects on park operations. The increased prescribed burn activities would create short-term, minor, adverse effects. Developing new interpretive and educational media would result in a short-term, minor-to-moderate, adverse effect on park operations in the early period of plan implementation. Implementation of a three-year research study to evaluate chronic wasting disease testing procedures and fertility control drug	construction and teardown of a temporary capture facility would result in a short-term, minor, adverse effect. The decreased need for traffic and crowd control would result in long-term, minor, beneficial effects. During lethal reduction activities, the increased need for visitor control would result in short-term, negligible-to-minor, adverse effects. The increased installation and maintenance of fences would result in short- and long-term, minor-to-moderate, adverse effects. Monitoring activities would create long-term, moderate, adverse effects. Redistribution techniques would result in long-term, moderate, adverse effects. The increased prescribed burn activities that would be conducted would create short-term, minor, adverse effects. Developing new interpretive and educational media would result in a short-term, minor to moderate, adverse effect on park operations in the first years of the plan.	adverse effects in the short term, but decline to short-term and minor for the remainder of the plan if wolves were successful. The tasks related to the capture facility would result in short-term, negligible-to-minor, adverse effects on park operations. Elk-human conflicts would decrease in the park, but the need for traffic and crowd control would slightly increase over time, resulting in short-term, minor, adverse effects. The increased installation and maintenance of fences would result in short- and long-term, negligible, adverse effects on park operations. Herding to a capture facility would have a long-term, minor, adverse effect. Prescribed burning would have short-term, negligible to minor, adverse effects. Information, education, and outreach activities associated with the wolf release program would result in a moderate to major, adverse effect, which would be reduced to minor

TABLE 2.4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES (CONTINUED)

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Park Operations (continued)		on park operations in the early period of plan implementation. Implementation of a three-year research study to evaluate chronic wasting disease testing procedures in a free-ranging population in concert with elk management activities would result in a negligible adverse effect. Cumulative effects would be long-term, minor to moderate, and adverse.	effectiveness in a free-ranging population in concert with elk management activities would result in a negligible adverse effect. The cumulative effects would be long term, minor to moderate, and adverse.	Implementation of a three-year research study to evaluate chronic wasting disease testing procedures and fertility control drug effectiveness in a free-ranging population in concert with elk management activities would result in a negligible adverse effect. The cumulative effects would be long term, minor to moderate, and adverse.	in the long term. Initial integration of wolves and lethal reduction into interpretive materials would result in a short-term, moderate to major, adverse effect that would reduce to minor in the long-term. Increased monitoring under this alternative to include wolf activity and visitor response to wolves would result in long-term, moderate adverse effects. Implementation of a three-year research study to evaluate chronic wasting disease testing procedures in a free-ranging population in concert with elk management activities would result in a negligible adverse effect. The cumulative effects would be long-term, minor to moderate, and adverse.

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